A VIRTUAL PROFESSIONAL LEARNING COMMUNITY SUPPORTING TECHNOLOGY INTEGRATION IN A 1:1 CHROMEBOOK SCHOOL DISTRICT

by

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A dissertation submitted to Johns Hopkins University in conformity with the requirements for the degree of Doctor of Education

Baltimore, Maryland

July 2021

Abstract

School district leaders provide public school teachers with technology to use in their classrooms without addressing the factors that affect implementation and integration to benefit students' learning. In the context of this study, technology implementation is defined as having access to and using technology, and technology integration is defined as incorporating technology confidently and successfully into the curriculum on a daily basis to support student learning and 21st century skills. The focus of the convergent parallel mixed-method study was to support technology integration for kindergarten through eighth grade classroom teachers through a virtual professional learning community (PLC). Framed around a constructivist and connectivist approach to learning, participants had access to support, resources, and collaboration through a virtual PLC that provided teachers with the opportunity to build their technology skills and confidence. The intervention was conducted from October 2020 to March 2021 with 15 participants from two schools. The study was conducted during the Coronavirus (COVID-19) pandemic. Qualitative and quantitative data were collected concurrently. Data analysis occurred qualitatively through thematic analysis and quantitatively through descriptive statistics. The overall results of the study revealed that the virtual PLC was able to provide support, resources, and collaboration opportunities for participants to build their technology skills and confidence, helping to foster technology integration. The discussion board section of the virtual PLC was found to be the most useful to the participants in providing support and collaboration opportunities. The virtual PLC was found to be successful in an extremely difficult school year.

Keywords: virtual professional learning community, informal learning, technology integration, collaboration, technology support, teacher technology skills, teacher technology confidence

Primary Readers and Co-Advisers: Dr. Elizabeth Brown and Dr. Margaret Perry

JOHNS HOPKINS
SCHOOL of EDUCATION

Dissertation Approval Form

Student's Name: Brielle Kociolek Date: July 26, 2021

Dissertation Title:

A VIRTUAL PROFESSIONAL LEARNING COMMUNITY SUPPORTING TECHNOLOGY INTEGRATION IN A 1:1 CHROMEBOOK SCHOOL DISTRICT

The student has made all necessary revisions, and we have read, and approve this dissertation for submission to the Johns Hopkins Sheridan Libraries as partial fulfillment of the requirements for the Doctor of Education degree.

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Dedication

This dissertation is dedicated to my parents, who taught me from a young age to believe in myself and to reach for the stars. Their love, encouragement, and support has allowed me to become a strong, independent woman who is not defined by having dyslexia. Instead, my dyslexia has taken me on a journey that I have be able to grow through to have the ability and confidence to achieve this degree. Thank you for all you have done for me and for your continuous support through this whole journey.

Love you Mum and Dad.

Acknowledgments

I would like to first thank my dissertation committee members, Dr. Brown, Dr. Borkoski, and Dr. Perry. Thank you for taking the time and having the patience to help me through this whole process. Dr. Brown and Dr. Perry, thank you for spending so much time on helping me develop and build my writing as well as helping me to building my confidence as a researcher and writer. Without the both of you, I don't think I would have made it to the end. I truly appreciate all the time and dedication you have shared with me.

I want to thank my amazing friend and co-worker, Mary Beth Florez. Without you, I would have not survived the writing or research processes of my dissertation. For the hours upon hours you spent editing my chapters and just being there to walk through all my ideas, I will always be truly grateful. Thank you for taking the time to listen to me and help me to understand the rules of grammar and the writing process. This dissertation and degree will always be practically yours. I am truly blessed to have you as a friend, and I hope you know what an amazing English teacher and person you are.

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Executive Summary

The focus of this convergent parallel mixed-method study was to support technology integration for classroom teachers through a virtual professional learning community (PLC). Framed around a constructivist and connectivist approach to learning, the virtual PLC provided participants access to support, resources, and collaboration, providing teachers with the opportunity to build their technology skills and confidence while fostering technology integration (Booth & Kellogg, 2015; Ertmer & Newby, 1993; Kafyulilo, Fisser, & Voogt., 2014; Siemens, 2004). The intervention was built through a Google site called the Technology Support and Innovation Site (TSIS) and was composed of four sections, including a discussion board.

Problem of Practice

School district leaders provide public school teachers with technology to use in their classrooms without addressing the factors that affect implementation and integration to benefit students' learning (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Knott, Steube, & Yang, 2013; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Overbay, Mollette, & Vasu, 2011). The implementation of technology is affected by external and internal factors (Angers & Machtmes, 2005; Ertmer et al., 2012). In the context of this study, internal factors were the focus of the literature review because the researcher's school district addressed external factors, including infrastructure and access to technology. Failing to address internal factors leads to the underutilization of technology in the classroom (Cuban, Kirkpatrick, & Peck, 2001; Ruggiero & Mong, 2015). The research in this review shows evidence of the teachers' internal factors and what role these factors play in technology implementation and integration. The factors described include beliefs, confidence, training, support, technology policies and plans, and 21st century skills (Ertmer et al., 2012; Wachira & Keengwe, 2011; Wetzel, 2001).

Theoretical Framework

A constructivist approach to learning was the theoretical framework for the intervention because learning occurs from pre-existing knowledge and personal learning experiences (Ernest, 2010). Using a constructivist approach with technology integration develops an environment for learners that can expand beyond the classroom and include enhanced learning opportunities (Pittman & Gaines, 2015). Derived from constructivism is a newer learning approach, called connectivism (Siemens, 2004). Siemens (2004) developed this theory to better understand how digital technology can expand learning. Employing constructivist and connectivist approaches to learning as the framework for the intervention at Ocean School District enabled the teachers to expand their professional network of support and resources.

Synthesis of Relevant Research Literature

Through the review of literature, four types of interventions were identified: professional development, informal learning, professional learning communities, and communities of practice. After reviewing the different intervention approaches a virtual PLC was built around an informal learning platform, providing a place to access resources, sharing, and collaboration (Ernest, 2010; Greenhow & Askari, 2017; Kamalodeen & Jameson-Charles, 2016; Rashid et al., 2016; Song & Bonk, 2016).

Informal learning. Informal learning is a voluntary activity of pursuing knowledge through external methods, which may include online communities, where the learner is engaging with colleagues through shared learning, reflection, and support (Macia & Garcia, 2016). Informal learning connects with a connectivist approach to learning, where participants use networks to acquire their knowledge voluntarily (Macia & Garcia, 2016). The key findings of the studies reviewed were that informal learning sites and social networking sites provide teachers

with opportunities for sharing, networking, and collaborating, all of which can provide teachers with technology integration support, resources, skills, and confidence (Greenhow & Askari, 2015; Kamalodeen & Jameson-Charles, 2016; Rashid, Yahaya, Rahman, & Yunus, 2016; Song & Bonk, 2016).

Professional learning communities. A PLC is created to promote peer collaboration, access to resources, and support and occurs face-to-face, virtual, or a blend of both (Booth & Kellogg, 2015; Duncan-Howell, 2010; Henderson, 2007; McConnell, Parker, Eberhardt, Koehler, & Lundeberg, 2013). Ertmer, Ottenbreit-Leftwich, and York (2014) explain that continued access to support and resources is key to supporting teachers' skills and confidence in technology integration. Using an online community creates opportunities for teachers to collaborate, expand their professional earning community, participate in discussions, and gain relevant resources to use in their classroom (Booth & Kellogg, 2015; Duncan-Howell, 2010). PLCs align with constructivist and connectivist approaches to learning because they connect the learners to the environment around them to build on their learning experiences.

Research Purpose

The purpose of the study was to provide a platform for teachers to access and use resources and support, build technology skills, and increase confidence to promote technology integration in the classroom. The following research questions guided the study:

Process evaluation research questions.

RQ1A: To what degree did the implemented intervention adhere to the planned intervention?

RQ1B: To what degree did participants report the virtual PLC as useful?

RQ1C: To what extent were participants engaged with the content of the virtual PLC?

Outcome evaluation research questions.

RQ2: To what extent did teachers report that their skills levels changed after participating in the virtual PLC?

RQ3: To what extent did teachers' technology confidence change after participating in the virtual PLC?

RQ4: In what ways did participant support for technology integration change after participation in the virtual PLC?

RQ5: How did teachers collaborate during their participation in a virtual PLC?

RQ6: To what extent did teachers' technology integration change after participating in the virtual PLC?

Research Design

A convergent parallel mixed-method design was used to understand how the virtual PLC worked with two schools in the Ocean School District. The research questions were created to evaluate the short-term outcomes: improve technology skills and confidence levels of teachers, provide support and collaboration opportunities, and improve technology integration. Quantitative and qualitative measures were used to evaluate the short-term outcomes and fidelity of implementation.

Background and Context

The participants included 15 kindergarten through eighth-grade teachers at two public schools in the Ocean School District. School. All the teachers and students had district Google accounts and access to Google Suite. Intervention implementation occurred during the COVID-19 pandemic; subsequently, teachers had more responsibilities as they were required to

simultaneously teach students face-to-face and virtually, with what the school district leaders called blended learning.

Intervention

The intervention consisted of a virtual PLC using a Google site titled the Technology Support and Innovation Site (TSIS), conducted from October 2020 through mid-March 2021. The TSIS was composed of four sections, including a discussion board. The virtual PLC provided participants with access to technical support, resources, and collaboration to build teacher technology skills and technology confidence levels. The virtual PLC included 15 teachers from two schools.

Data Collection and Data Analysis

The process and outcome evaluation data were collected concurrently during the research study. The measures consisted of a pre/post survey, discussion board, reflective journal, focus group interviews, Google Analytics, and teacher-reviewed apps and sites.

Findings

In reviewing the findings of fidelity of implementation, the intervention was conducted as planned. The participants indicated during focus group interviews that the virtual PLC was useful, with the discussion board being the most useful section. Kamalodeen and Jameson-Charles (2016) categorized participants by how they took part in the study, ranging from those participants who took information but did not interact, content consumers and window-shoppers to participants fully engaged in the study, collaborators and content producers. Adopting the system of Kamalodeen and Jameson-Charles (2016), the researcher placed six participants in the virtual PLC under the category of content consumers and window-shoppers. Nine participants were placed under content producers and collaborators. The virtual PLC showed 160 visits, with

five participants making apps and sites recommendations, nine interacting on the discussion board, and the researcher posting 11 times to encourage participant engagement. The participants of the PLC recommended ways to notify participants of added reviewed apps and sites and posts on the discussion board to increase participant responsiveness.

The researcher found the participants collaborated and gained support on technology integration during the virtual PLC through observations of the discussion board and interactions with the researcher. The virtual PLC was an avenue for participants to have technology integration support with their colleagues. Regarding the findings for teacher confidence, skill levels, and technology integration, the results indicated growth from data collected in the focus group interviews but the pre/post survey did not reflect any change from pre to post.

Due to the COVID-19 pandemic and blended learning requirements by the school district, all the participants had to use technology in a greater capacity than before the pandemic. The increase in technology use might have affected the participants' skills and confidence, even without the virtual PLC. However, having a virtual PLC at this time might have given the participants comfort and confidence, knowing they had support for help. Overall, the findings showed that participants were able to acquire support, resources, and collaboration to build their technology skills and confidence while fostering technology integration.

Chapter 1: Overview and Factors Related to the Problem of Practice

Over the past 30 years, educators have incorporated technology, including computers and Internet, into U.S. schools and classrooms (Cuban, Kirkpatrick, & Peck, 2001; Culp, Honey, & Mandinach, 2005; U.S. Department of Education, 2016). Teachers used devices and software to foster student achievement of learning goals (Davies, 2011). Research has shown a progression of access to computers and the Internet in classrooms, but teachers face factors that create complications with using technology (Cuban et al., 2001; Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Wetzel, 2001). Among the factors teachers encounter are support, training, teacher beliefs, teacher confidence, technology plans, technology polices, and 21st century skills (An & Reigeluth, 2011; Ertmer et al., 2012; Hughes, 2005; Inan & Lowther, 2010a, 2010b). Through this research, an understanding of these factors was developed to show how teachers integrate and implement technology to support student learning.

For the purpose of this study, technology implementation and integration were defined from the research reviewed. Researchers define technology implementation as having access to and using technology in the classroom (Lu & Overbaugh, 2009; Pittman & Gaines, 2015). The National Center for Education Statistics (NCES, 2002) described technology integration as the process of "incorporating technology resources and technology-based practices into the daily routines, work, and management of schools" (p. 10). Others have defined technology integration as incorporating technology confidently and successfully into the curriculum to support students' learning daily (Pittman & Gaines, 2015). Integrating technology into the curriculum and instruction can support students' 21st century skills by experiencing meaningful tasks that can build higher order thinking (Polly & Hannafin, 2010, p. 557). Staff at the southern school district, where this study occurred, followed state and national technology recommendations and

implemented a technology plan to provide 1:1 Chromebooks for all kindergarten through eighth graders. Understanding the factors affecting a teacher's ability to implement and integrate technology successfully into the daily workings of the classroom is an essential step in reaching state and national technology recommendations.

Problem of Practice

School district leaders provide public school teachers with technology to use in their classrooms without addressing the factors that affect implementation and integration to benefit students' learning (Ertmer et al., 2012; Knott, Steube, & Yang, 2013; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Overbay, Mollette, & Vasu, 2011). The implementation of technology is affected by external and internal factors (Angers & Machtmes, 2005; Ertmer et al., 2012). In the context of this study, internal factors were the focus of this literature review because the researcher's school district addressed external factors, including infrastructure and access to technology. When the internal factors remained unaddressed, it leads to the underutilization of technology in the classroom (Cuban et al., 2001; Ruggiero & Mong, 2015). The research in this review shows evidence of the teachers' internal factors and what role these factors play with technology implementation and integration. The factors described include beliefs, confidence, training, support, technology policies and plans, and 21st century skills (Ertmer et al., 2012; Wachira & Keengwe, 2011; Wetzel, 2001).

Theoretical Framework

To identify how the factors of the problem of practice (POP) affected teachers' abilities to implement and integrate technology, ecological systems theory (EST) was used as the framework. The EST model is a nested system arranged from the inner circle—microsystem, mesosystem, and exosystem—to the outer circle—the macrosystem. These systems show the

individual as the center, moving outward through different settings or environments that influence the individual directly and indirectly (Bronfenbrenner, 1979; Neal & Neal, 2013). The researcher used this framework to illuminate the relationships among teachers, technology implementation, and technology integration in the classroom and to examine how identified factors impacted teachers' use of technology.

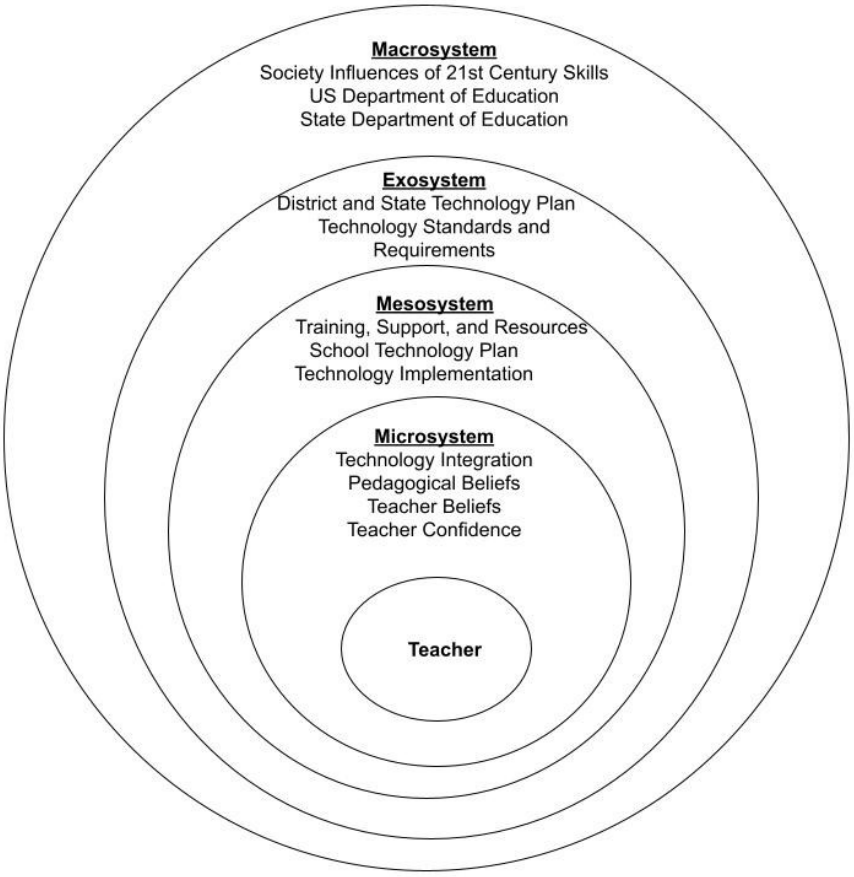

Figure 1. Ecological systems theory model.

The EST model illustrated in Figure 1, adapted from Bronfenbrenner's (1979) nested model, showed a visual of how different factors from each part of the EST played a role in how teachers implemented and integrated technology. Nested in the center of the model is the microsystem where the focal individual, the teacher, plays a direct role influenced by interactions and experiences of different relationships (Bronfenbrenner, 1994; Neal & Neal, 2013). The

teacher in the microsystem is affected by their beliefs and confidence levels. In the context of technology integration, the teacher is influenced by the provided technology within the microsystem. How the teacher integrates technology in the classroom influences students' learning.

Surrounding the microsystem is the mesosystem, where social interactions occur between two or more settings (Bronfenbrenner, 1994; Neal & Neal, 2013). In the mesosystem, two different settings connect through interactions. Bronfenbrenner (1979) explained that adding settings outside the classroom and building relationships that had connections with these settings moved into the mesosystem. In this context, the mesosystem consists of the school's technology plan, support, training, and implementation. Each school leader can determine the technology plan that best fits their teachers and students, aligning to district and state requirements. The decisions from the mesosystem are influenced by systems in the exosystem and how technology should be implemented, including the district technology plan and state technology standards, policies, and requirements.

The teacher holds less of a direct role in the exosystem. Although the individual is influenced by the exosystem, they do not have a direct role in shaping discussions or plans created in the exosystem (Bronfenbrenner, 1979; Neal & Neal, 2013). The exosystem, in the context of this study, was the school district's technology plan. The district plan included how and what technology was purchased and recommendations for implementation in the school. The exosystem in this study also included the policies in place by the district technology plan that influenced how teachers accessed and used the technology provided. The state, in which this study was conducted, had a technology plan that included technology standards and requirements that influenced the district technology plan. In turn, the district technology plan was created by

the superintendent, district employees, administrators from schools in the district, and the school board based on state expectations.

The outer level of the EST model is the macrosystem, which encompasses the society or the culture with which a researcher focuses (Bronfenbrenner, 1994; Neal & Neal, 2013). The macrosystem include the U.S. Department of Education (2016) and state departments of education that influence prescribed policies for school districts. The societal views that influence the policies from the departments include teaching students 21st century skills to be successful citizens in society.

Organizing and examining the factors surrounding teachers' technology implementation and integration frame the literature review. Based on the EST model, the literature review is organized starting with the mesosystem's technology beliefs and confidence. Then the literature review includes examinations of the mesosystem and exosystem: how the technology plans by the school, district, and state affect how technology is implemented in the classroom. The literature review concludes with the macrosystem to examine 21st century skills.

Review of the Literature

Teachers' successful technology integration and implementation can provide students with enhanced learning opportunities and give them the opportunity to apply 21st century skills (Hsu, 2016). Because successful technology integration and implementation have the potential for positive impacts on student learning, one should understand the factors that can affect integration and implementation (Lei & Zhao, 2007). The factors of teacher beliefs, teacher confidence, technology support, technology training, technology policies, technology plans, and 21st century skills are defined, examined, and discussed in the literature review. Examining these

factors through the research shows the direct and indirect ways each may influence teachers in integrating and implementing technology.

Teacher confidence. Confidence refers to the ability of the teacher to perform the task, technology implementation and integration successfully (Ertmer & Ottenbreit-Leftwich, 2010). Teachers' interactions and experiences place them in the center of the microsystem where confidence plays a direct role on their technology implementations and integrations (Bronfenbrenner, 1994; Neal & Neal, 2013). Building confidence in technology use is a process that includes individual and environmental factors (Inan & Lowther, 2010a).

Inan and Lowther (2010a) examined teachers' individual characteristics and environmental factors to determine the influence on how they integrated technology. The participants included 1,382 teachers from 54 Tennessee public schools participating in a technology launch program (Inan & Lowther, 2010a). Data were collected with the Teacher Technology Questionnaire, a two-part survey, to identify what factors affected participants' technology integration (Inan & Lowther, 2010a). Data were analyzed through assumption checking, interaction analysis, and path model estimates (Inan & Lowther, 2010a). The variables analyzed included teacher beliefs, readiness, and computer proficiency (Inan & Lowther, 2010a). The results indicated that teacher readiness, beliefs, and the availability of technology influenced technology integration, with teacher readiness having the highest impact on integration (Inan & Lowther, 2010a). Using these findings, Inan and Lowther (2010a) defined teacher readiness as how teachers perceived their skills and capabilities for integrating technology, which in turn influenced teachers' confidence in using the technology. The researchers concluded that, when teachers felt ready, they approached technology with more confidence and had more success implementing technology.

Teachers need confidence to feel a level of comfort before using the technology (Hsu, 2016; Inan & Lowther, 2010a). Giving teachers the technology does not mean that they will be confident about using that technology. Using a case study, Hsu (2016) examined teachers' beliefs about technology integration, the technology used, and the barriers teachers encountered when integrating technology. Participants included 153 teachers who were part of a school district that had a partnership with an education program at a university that provided technology resources (Hsu, 2016). The teachers took a survey, and eight teachers were interviewed and observed. Data were collected through online surveys, face-to-face interviews, and observations (Hsu, 2016). The researcher used qualitative analysis and cross-case analysis for interviews and observations (Hsu, 2016). The survey data showed that 91% of the teachers had positive views of the value of technology, and 83% had high self-efficacy beliefs toward technology integration (Hsu, 2016). Hsu (2016) suggested that the university leaders providing the school district with a variety of technology resources built teacher confidence and helped to develop their beliefs. The researcher identified factors that teachers faced including how to integrate technology into their lessons, students not having sufficient computer skills, teachers not having enough training or time with implementing technology, and teachers lacking technology integration support (Hsu, 2016). Leaders addressing these factors could help build teacher confidence with successfully implementing and integrating technology in their classrooms.

Researchers have shown that teachers need to have confidence to use the technology to improve technology integration (Hsu, 2016; Inan & Lowther, 2010a; Vannatta & Fordham, 2004). Hsu (2016) studied a partnership with a local university while Inan and Lowther (2010s) studied a school technology launch. Hsu's (2016) teacher participants were more ready to implement and integrate technology than Inan and Lowther's (2010a) participants. Part of the

reason, according to Hsu (2016), that participants were better prepared was the local university helped build the teachers' confidence and beliefs in technology. Readiness and confidence are built through professional development (PD) focusing on the context of the teacher and providing the opportunity to work with higher-order learning activities where staff integrate technology (Inan & Lowther, 2010a). Hsu (2016) and Inan and Lowther (2010a) suggested teachers should have belief, confidence, and self-efficacy in technology integration. In addition, they need readiness, a willingness to change, and time for exploring and building technology skills (Hsu, 2016).

Teacher beliefs. Beliefs refer to teachers' values influenced by how they teach, why they teach, their feelings of success and failure, and what they accomplish (Cuban, 2001). Teachers' beliefs influence their choices made in the classroom, placing beliefs in the center of the microsystem with confidence (Bronfenbrenner, 1994; Cuban, 2001; Neal & Neal, 2013). In a multiple case study, Ertmer et al. (2012) examined teacher beliefs and technology integration practices to understand how teachers put their beliefs into practice. Twelve technology award-winning teachers were interviewed, and 41 teacher websites were observed to collect data on external and internal factors that teachers faced with technology integration (Ertmer et al., 2012). During the interview, teachers were asked to rate the factors that affected students' use of technology (Ertmer et al., 2012). The researchers analyzed the interview results through a constant comparison method, and websites were analyzed for student-centered technology use (Ertmer et al., 2012). The researchers found external factors, including technology support and state standards, had more of an impact on technology integration than internal factors. The most influential internal factors included teachers' inner drivers and personal beliefs (Ertmer et al., 2012). Teacher beliefs have an impact on technology integration (Ertmer et al., 2012), and

technology support in the form of PD should start with technology knowledge, skills, and resources to build teacher confidence and beliefs (Ertmer et al., 2012).

Teachers determine how to integrate technology in the curriculum and use it in the classroom. Palak and Walls (2009) examined the types of instruction that teachers used with technology and the connection it had with their teaching beliefs about technology. The research was conducted with 113 teachers from 28 K-12 schools in West Virginia. These schools had available technology and participated in a specific technology PD (Palak & Walls, 2009). Data were collected through two surveys, the Inventory of Philosophies of Education and the Perceptions of Computers and Technology, for evidence on teachers' beliefs about technology and technology practices (Palak & Walls, 2009). In addition to the survey data, the researchers also collected qualitative data by selecting four teachers for observations, interviews, and reviews of lesson plans. Data were analyzed quantitatively and qualitatively to determine the influence that teachers' beliefs had on technology integration. The findings indicated that even in schools with an abundance of technology and teachers who incorporated technology into instruction, some teachers did not move toward technology integration (Palak & Walls, 2009). The amount of integration depended on the teacher's decision to use technology, with their beliefs being the most significant predictor of technology integration in the classroom (Palak & Walls, 2009).

Vannatta and Fordham (2004) also studied teachers' dispositions and beliefs to determine if these predicted technology usage in K–12 classrooms. The participants included 177 elementary and high school teachers from Ohio taking part in a three-year grant that provided technology training. Data were collected using the researcher-created Teacher Attribute Survey and analyzed using descriptive statistics (Vannatta & Fordham, 2004). The researchers found the

best predictor of using technology was a combination of teachers' beliefs, willingness to change, amount of PD, and personal time spent exploring technology (Vannatta & Fordham, 2004). This willingness to change may have been influenced by the type of PD that teachers were provided (Vannatta & Fordham, 2004).

Teachers will use the technology if it supports their pedagogical beliefs (Ertmer et al., 2012; Palak & Walls, 2009). Inan and Lowther (2010b) conducted a follow-up study to examine the factors that impacted technology integration in classroom instruction. The participants included 379 teachers from 76 private and public schools in Michigan. Data were collected using the Freedom to Learn-Teacher Technology Questionnaire (Inan & Lowther, 2010b). The researchers used path analysis to statistically analyze variables identified through the questionnaire (Inan & Lowther, 2010b). As in Inan and Lowther's (2010a) earlier study, the researchers defined technology integration as a complex process in which teachers were influenced by direct and indirect factors. The direct variables identified as having the most significant impact on technology integration included teacher readiness, teacher computer proficiency, teacher beliefs, technology support, and teacher technology use (Inan & Lowther, 2010b). These same variables were also identified in the teacher confidence studies as directly influencing technology integration and implementation (Inan & Lowther, 2010b; Vannatta & Fordham, 2004). Inan and Lowther (2010b) found that teacher readiness and teacher beliefs had the greatest effect on technology integration. Unlike Ertmer et al. (2012) and Palak and Walls (2009), Inan and Lowther (2010b) went further into understanding teacher beliefs and found that teacher beliefs were affected by both direct and indirect influences, including technology support through collaborative learning communities and PD training on technology skills (Inan & Lowther, 2010b).

Technology and training offered to teachers that does not consider their beliefs can cause a breakdown in technology integration (Ottenbreit-Leftwich et al., 2010). Ottenbreit-Leftwich et al. (2010) examined how teacher beliefs affected the use of technology in the classroom. The participants in this case study included eight K-12th grade teachers selected because they had implemented and integrated technology in their classrooms. Data were collected through interviews, observations, and portfolios to understand why these teachers integrated technology and teachers' valued beliefs in using technology (Ottenbreit-Leftwich et al., 2010). The researchers analyzed the results by creating a case record for each teacher, then conducting a cross-case analysis (Ottenbreit-Leftwich et al., 2010). The researchers considered the data to determine if similar themes or patterns occurred from these eight teacher participants, finding that teacher beliefs did play a role in how they used technology (Ottenbreit-Leftwich et al., 2010). The first theme was the following: Teachers used technology professionally for creating classroom materials and organizing their classrooms (Ottenbreit-Leftwich et al., 2010). The second theme uncovered was that teachers used technology to meet student needs, including higher-level thinking, motivation, and engagement (Ottenbreit-Leftwich et al., 2010). Ottenbreit-Leftwich et al. (2010) found that teachers used technology to address their instructional goals with their valued beliefs tied to student learning.

Teachers view the integration and implementation of technology through their teaching beliefs, knowledge, and curriculum (Sugar, Crawley, & Fine, 2004). Sugar et al. (2004) examined teachers' beliefs in a two-part study to determine how the beliefs affected what new technology was integrated into the classroom. The first part included six high school teachers, and the second part included 107 K–12 teachers from four schools in the southeastern area of the United States. Data were collected through open-ended and closed-ended questionnaires in semi-

structured interviews. The results indicated that training, including support and resources, had a positive influence on teacher attitudes, allowing for greater adoption of technology (Sugar et al., 2004). Knowing how technology affected their roles could help teachers integrate and implement the technology effectively (Sugar et al., 2004). Just focusing on how to align teacher technology beliefs and practices does not mean technology integration will take place; teachers need support and training to foster and build technology confidence and beliefs (Ertmer et al., 2012). Through targeted support and training, teachers gain access to methods of meeting instructional goals through technology integration. Teachers who increase their knowledge of technology can change their attitudes, confidence, and beliefs toward technology integration (Ertmer et al., 2012; Inan & Lowther, 2010a, 2010b; Sugar et al., 2004). The teacher's level of knowledge with the technology builds technology beliefs, which can determine the role that technology plays in the classroom.

In Ertmer et al. (2012) and Ottenbreit-Leftwich et al.'s (2010) studies, a small number of teachers were selected to take part based on their roles in implementing and integrating technology into the classroom. The researchers found that teacher beliefs played an important role in how teachers implemented and integrated technology (Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010). In larger samplings, such as from Inan and Lowther (2010b) and Palak and Walls (2009), teachers' technology beliefs were still found as one of the greatest factors influencing technology integration and implementation. Each of the studies on teachers' beliefs indicated that to support teacher technology integration and implementation, PD needed to be designed around teacher beliefs while focusing on how to connect their beliefs with technology applications (Ertmer et al., 2012; Inan & Lowther, 2010b; Ottenbreit-Leftwich et al., 2010; Palak & Walls, 2009; Sugar et al., 2004). Increasing teacher technology knowledge and skills can also

increase technology confidence, influencing teachers' beliefs about technology integration and implementation. The impact of technology support and PDs on teachers' beliefs and confidence is explored next in the review.

Training and support. The school district and school administration determine the training and support provided, taking the decision out of teachers' hands and moving it into the mesosystem where social interactions occur between two or more settings (Bronfenbrenner, 1994; Neal & Neal, 2013). Training is determined by the technology plan and policies created by schools, districts, and state and federal governments. Leaders of schools and school districts must rethink teacher training to understand how they can provide training to build skills and provide tools and techniques to support student learning (Buckenmeyer, 2010; Overbay et al., 2011; U.S. Department of Education, 2016). Finding the appropriate training and giving teachers the time to incorporate this training can lead to successful technology integration (Buckenmeyer, 2010).

In the mesosystem, examining training and support is the next step in understanding the challenges that teachers face in technology implementation and integration to support student learning. Teachers take part in provided training, creating social interactions outside of teachers' classroom settings (Neal & Neal, 2013). Teachers' training and support provided to integrate and implement technology play a role in how they build their beliefs and confidence and use the technology to support their curricula. PD and teacher collaboration can provide training for teachers (Buckenmeyer, 2010; Mouza, 2009). In Buckenmeyer's (2010) study of what conditions prompt teachers to integrate technology, 144 high school teachers from the Midwest took part in PD on educational technology. Data were collected through a survey to determine the predictors of technology adoption (Buckenmeyer, 2010). The researcher analyzed the results by first evaluating the survey and conducting a relationship analysis between individual items and

technology use; the researcher also used regression analysis (Buckenmeyer, 2010). They found that teachers need individual time to learn the technology and learn how to integrate the technology (Buckenmeyer, 2010). Many teachers desired additional training and support with technology integration and found the training helped them adopt the technology into their classrooms (Buckenmeyer, 2010). The researcher found that training and support connected to student learning had an impact on teachers' lessons and decisions to integrate technology (Buckenmeyer, 2010).

Successful, high-quality PD must remain engaging, content-specific, and long-term for teachers to create rigorous technology-rich lessons (Kulpa, 2015; Mouza, 2009). Researchers have defined PD on technology integration, paradoxically, as beneficial and meaningless by teachers (An & Reigeluth, 2011; Buckenmeyer, 2010). An and Reigeluth (2011) studied how to support teachers in creating technology-enhanced classrooms with a focus on learner-centered classrooms. The factors included beliefs, perceptions, barriers, and support (An & Reigeluth, 2011). The study consisted of 126 K-12 teachers from 27 schools throughout the southern United States. Data were collected through an online survey, including open-ended questions, analyzed quantitatively through descriptive statistics and qualitatively through the constant comparative method (An & Reigeluth, 2011). The researchers found that technology integration factors included a lack of time and too broad training topics, meaning that teachers saw PD as cramming a large amount of information in a short time (An & Reigeluth, 2011). The authors concluded that finding ways to provide more specialized PD was a possible step in strengthening technology integration in the classroom (An & Reigeluth, 2011; Mouza, 2009). Teachers need PD focused on how technology has been integrated and implemented in a variety of content area lessons using different strategies (Ruggiero & Mong, 2015). One strategy for moving teachers

toward integrating technology is to provide them with training and resources about styles of instruction that incorporate technology (An & Reigeluth, 2011; Keengwe, Schnellert, & Mills, 2012; Palak & Walls, 2009; Ruggiero & Mong, 2015).

Teachers can use specialized PD to understand how to create connections between what they teach and technology (An & Reigeluth, 2011; Hughes, 2005; Ruggiero & Mong, 2015). Hughes (2005) used a multiple-case study design to examine how teacher learning during PD could create technology-supported pedagogy. The participants included four English language arts teachers. Data were collected through interviews and observations, and a cross-case analysis was conducted to determine what patterns emerged (Hughes, 2005). The researcher uncovered the first theme: Informal learning experiences created opportunities for teachers to implement and integrate the technology. One way that informal learning occurred was through colleagues' recommendations and demonstrations (Hughes, 2005). The second and third themes showed that when the technology learning experiences were connected and focused on the content, the teachers found value in technology integration (Hughes, 2005). If learning experiences focus on technology, teachers will not necessarily use technology integration and implementation because these learning experiences lack a connection to content-specific instruction (Hughes, 2005). Creating learning experiences with technology built around teachers' content areas can create technology-integrated lessons. Similar to the Hughes (2005) study, the Ertmer et al. (2012) and the Palak and Walls (2009) studies suggested PD on integrating technology should be connected to the curriculum. Through participating in content-specific PD, teachers can build their knowledge of, skills in, and beliefs about technology implementation and integration.

Teachers want the opportunity for hands-on, content-specific PD that provides more time to explore approaches to technology integration and implementation (An & Reigeluth, 2011).

Thus, PD that will meet the varied needs of teachers' technology skills and pinpoint the training is needed to advance those skills. Pittman and Gaines (2015) studied the usage of technology in the classroom compared to access to technology, support, PD, beliefs, and barriers to technology integration. The study participants were 75 third- to fifth-grade teachers in a Florida school district. Data were collected through a researcher-created online survey. Descriptive statistical analysis was completed on the demographic information, and correlation analysis was used to determine the relationships among integration, access, support, PD, and attitudes on technology integration (Pittman & Gaines, 2015). The results indicated a positive correlation between PD and teacher attitudes that led to technology being adopted into their classrooms (Pittman & Gaines, 2015). Teachers wanted further training on, time with, and support for technology integration (Buckenmeyer, 2010; Pittman & Gaines, 2015). The researchers identified that PD focused on technology integration and time to work with the technology would be beneficial to teachers (Pittman & Gaines, 2015). An and Reigeluth (2011), Buckenmeyer (2010), and Pittman and Gaines (2015) used a survey to identity the ideal conditions for teachers integrating and implementing technology. The results of all three studies were similar: Time, training, specialized PD, and support influenced how teachers implemented and integrated technology (An & Reigeluth, 2011; Buckenmeyer, 2010; Pittman & Gaines, 2015).

In an earlier longitudinal study, Mouza (2009) examined how PD in technology could help teachers gain growth and knowledge to sustain technology better over the long term. Seven urban elementary teachers participated in a three-year study. Data were collected through observations, interviews, pre- and post-surveys, artifacts, and email exchanges. The researcher analyzed the survey data using descriptive statistics and case study analysis for the qualitative data (Mouza, 2009). Mouza (2009) found that teachers could use PD to maintain and further

their skills, increase their awareness of how to integrate technology, and build their technology pedagogies. The researcher stated that the seven teachers maintained and built technology skills learned from PD during the first year of the study (Mouza, 2009). Mouza (2009) noted that both teachers' practices and beliefs affected technology integration. Both Hughes (2005) and Mouza (2009) conducted case studies and interviewed a small sample of teachers to understand how teachers learned through technology PD. The researchers found that PD needed to be content focused on building technology integration into the classroom while recognizing that teachers' beliefs and values impacted technology integration (Hughes, 2005; Mouza, 2009).

A review of the research shows training and support, specifically PD, as factors that influence technology integration (An & Reigeluth, 2011; Buckenmeyer, 2010; Hughes, 2005; Mouza, 2009; Pittman & Gaines, 2015). PD is provided to teachers in different ways throughout schools, but the focus needs to move toward training that allows teachers to develop their skills and create lessons that effectively incorporate technology (Buckenmeyer, 2010; Mouza, 2009; Pittman & Gaines, 2015). PD is the strongest factor affecting teacher readiness to integrate technology (Inan & Lowther, 2010b). One suggestion on how to change teachers' pedagogical beliefs is through PD with a focus on current and authentic ways of integrating technology (Ertmer et al., 2012). Each of the studies reviewed on training and support showed the same key findings through different approaches: PD needs to be content focused, time needs to be given to allow teachers to work with the technology, and support needs to be provided during the implementation and integration process (An & Reigeluth, 2011; Buckenmeyer, 2010; Hughes, 2005; Mouza, 2009; Pittman & Gaines, 2015).

Technology policy and plan. The U.S. Department of Education (2016) created a national vision for educators on integrating technology to support student learning by publishing

the National Education Technology Plan in 2016. Ritzhaupt, Hohlfeld, Barron, and Kemker (2008) defined an effective technology plan as including rollout and implementation of the technology, evaluations, development processes, training, and review. Technology plans are created for the long term and should include funding sources, technology implementation and sustainability, timelines, infrastructure, evaluation, and revisions (Culp et al., 2005; NCES, 2002; Ritzhaupt et al., 2008). Districts, schools, and teachers can use a technology plan to gain guidance and an explanation of the technology policies in place at national and state levels. The district and state technology plans are part of the EST exosystem (Bronfenbrenner, 1979; Neal & Neal, 2013). How teachers are trained, the technology provided, and the role this technology plays in the classroom are all determined by technology policies created with limited teacher input. Through different policies, school district leaders create technology plans that should include a vision for, access to, and integration of the technology. These technology plans should consider students and teachers to guide implementing and integrating technology into the classroom (McLeod, Richardson, & Sauers, 2015; Ritzhaupt et al., 2008).

When creating a technology plan, leaders of schools and districts need to keep in mind the technology policy requirements created by federal, state, and local agencies (NCES, 2002). Ritzhaupt et al. (2008) investigated how Florida K-12 public schools trended in technology planning and funding. The participants included 1,480 public school principals and technology coordinators. Data were collected from a survey during 2003 to 2006 to understand the trends in technology planning and funding. Data analysis consisted of a two-way factorial logistical model (Ritzhaupt et al., 2008). The results showed that most Florida school leaders annually evaluated and revised their technology plans (Ritzhaupt et al., 2008). Stakeholders, including parents, administrators, and teachers from the schools sought funding for technology and invested time in

planning technology integration and implementation (Ritzhaupt et al., 2008). Based on the findings of the Florida study, stakeholders from different parts of the school district and community should be identified and involved in creating this plan to ensure that funding, maintenance, implementation, and evaluation are included (McLeod et al., 2015; Ritzhaupt et al., 2008). The stakeholders should include school administration, district technology leaders, parents, teachers, and students (Ritzhaupt et al., 2008).

Like Ritzhaupt et al. (2008), McLeod et al. (2015) considered technology integration through the lens of stakeholders by investigating superintendents' perspectives on technology integration and leadership roles needed for a school district to have success with technology implementation and integration. The participants included 11 identified by the researchers as tech-savvy U.S. superintendents. Data were collected through semi-structured interviews and analyzed using inductive coding. McLeod et al. (2015) defined technology integration as a multifaceted process that needed superintendents who supported integrating technology. The results showed several areas that the superintendents saw as important to integrating technology successfully, such as identifying the obstacles faced when multiple initiatives occurred in the school district (McLeod et al., 2015). The participants identified that leadership should model technology integration and implementation (McLeod et al., 2015). The superintendents also explained that district leaders must understand adult learning and create PD to provide opportunities for teachers to embrace technology. Although Ritzhaupt et al. (2008) focused on technology plans and funding, McLeod et al. (2015) gathered superintendents' perspectives on implementing technology into a school district. The researchers suggested that for technology integration and implementation, teachers needed support, time, funding, and collaboration to be

considered when building district leaders' technology plans (McLeod et al., 2015; Ritzhaupt et al., 2008).

Both the McLeod et al. (2015) and Ritzhaupt et al. (2015) studies recommended considering all stakeholders when developing technology plans, so resources and support could be provided to integrate technology. All stakeholders should be involved in creating a technology plan reflecting the school's instructional needs for technology integration and the time for this integration to occur (McLeod et al., 2015; Ritzhaupt et al., 2008). Also, the administration should know of the technology, infrastructure needs, and training needs of teachers (McLeod et al., 2015). Ritzhaupt et al. (2008) suggested that teachers needed opportunities to have input on the school's technology plan. Providing all stakeholders with the opportunity to create a technology plan can create ownership for technology integration (Ritzhaupt et al., 2008). Schools are similar because leaders create technology plans dealing with technology integration; however, the schools differ regarding how leaders create those plans, evaluate those plans, and choose who is involved with the process (Ottenbreit-Leftwich et al., 2010; Ritzhaupt et al., 2008).

21st century skills. Stakeholders, including educators and business leaders, developed 21st century skills as a framework to create opportunities for students to become successful citizens in an ever-changing world (Partnership for 21st Century Learning, 2015). 21st century skills refer to the category of society or culture, representing a focus of the macrosystem. These skills encompass many different areas of the educational system and society (Bronfenbrenner, 1994; Neal & Neal, 2013). Teacher leaders of successful technology implementation in schools develop, support, and enhance students' 21st century skills that include creativity and innovation, critical thinking and problem solving, communication, and collaboration (Partnership for 21st

Century Learning, 2015). One goal of technology integration is to prepare students with 21st century skills, such as collaboration and critical thinking (Lowther, Inan, Ross, & Strahl, 2012).

Technology integration is a fundamental building block of 21st century education where leaders support students developing 21st century skills (Vockley, 2007). Members of the State Educational Technology Directors Association, the International Society for Technology in Education (ISTE), and the Partnership for 21st Century Skills (2015) developed an action plan on technology integration to enhance students' 21st century skills. Vockley (2007) identified obstacles that needed to be faced and provided fundamental building blocks and guiding questions for stakeholders when building technology integration plans and policies. Two obstacles identified in the action plan were that educators faced a narrow view of how technology was used in the classroom and the assumption that technology was already widely used in schools (Vockley, 2007). Vockley (2007) reported that 21st century skills, including inquiry, collaboration, and engagement, could be enhanced with technology integration. Guiding questions for stakeholders building plans and polices for technology integration focused on how to equip schools, ensure mastering of the right technology skills, provide PD that enabled technology integration supporting 21st century skills, and fund and support technology integration that emphasized the need for supporting 21st century skills (Vockley, 2007).

Leaders of the successful implementation and integration of technology develop students' 21st century skills (Lowther et al., 2012). Lowther et al. (2012) used a mixed-methods design to examine how laptop implementation impacted K-12 schools participating in a 1:1 (each student received a computer) laptop initiative. The 380 K-12 Michigan teachers in the study took part in a summer PD supported with assistance and training throughout the year. Data were collected through observations, surveys, student performance assessments, and technology benchmarks

(Lowther et al., 2012). Descriptive statistics were used to analyze the data. The one-to-one program was found to have a moderate impact on moving technology integration in a positive direction, with students working toward 21st century skills (Lowther et al., 2012). The researchers found that teachers used technology to support 21st century skills (Lowther et al., 2012).

Like Lowther et al. (2012), Ruggiero and Mong (2015) used a mixed-methods approach to examine what technology tools teachers used in the classroom to support student learning. Data were collected through a researcher-created online survey, in-person interviews, and online interviews. The researchers surveyed 1,048 teachers in the Midwest United States and interviewed 111 of those teachers on what technology they used in their instructions. The results were analyzed quantitatively through descriptive statistics and qualitatively through constant comparisons. The researchers found that teachers did not fully integrate technology (Ruggiero & Mong, 2015). Instead of technology integration, teachers had students use the technology for creating presentations, researching through the Internet, writing papers, watching videos, and playing games (Ruggiero & Mong, 2015). The researchers believed that teachers needed more opportunities for PD on using the technology so that they could create integrated lessons to allow students to engage and interact on deeper levels with technology (Ruggiero & Mong, 2015). Although teachers implement technology in the classroom, they did not integrate technology (Ruggiero & Mong, 2015).

Providing students with lessons that include technology allows them access to resources and experiences previously inaccessible (U.S. Department of Education, 2016). This approach allows for more authentic student learning and builds real-world skills, including collaboration with peers (An & Reigeluth, 2011). An and Reigeluth (2011) studied 126 teachers from the

southern United States who took part in an online survey to identify the barriers affecting teachers who wanted to support student learning through technology. Data were collected through a survey, and results were analyzed using descriptive statistics. The factors identified were lack of time, required state testing, access to technology, perception of technology integration, and too broad PD (An & Reigeluth, 2011). The researchers suggested PD that considered linking the technology with the content being taught, more training, customized training, and communities of practice (CoPs) would support teachers in addressing these factors and support student learning through technology implementation and integration (An & Reigeluth, 2011).

Research shows that technology integration can enhance students' 21st century skills (Lowther et al., 2012; Vockley, 2007). Technology is used in classrooms, but a lack of PD and training limits teachers' abilities to move further into technology implementation and integration, hindering their abilities to enhance students' 21st century skills (Lowther et al., 2012; An & Reigeluth, 2011; Ruggiero & Mong, 2015). Lowther et al. (2012) suggested teachers had access to PD and support on technology implementation and integration throughout the year. An and Reigeluth (2011) and Ruggiero and Mong (2015) suggested that teachers should focus on specific topics while considering the amount of content being presented and time spent on training. The researchers found that teachers used technology but had not reached their long-term goal of technology integration in their classrooms, which would build students' 21st century skills (An & Reigeluth, 2011; Lowther et al., 2012; Palak & Walls, 2009; Ruggiero & Mong, 2015). Teachers have implemented technology by having students use the technology, but teachers have not fully integrated technology (An & Reigeluth, 2011; Ruggiero & Mong, 2015).

Teachers need support, training, and collaboration to create lessons to integrate technology and build students' 21st century skills (Vockley, 2007).

Summary

Technology implementation and integration is a complex process that involves many factors that affect success, including teacher beliefs, teacher confidence, training, support, technology policies, 21st century skills, and technology plans (Ertmer et al., 2012; Inan & Lowther, 2010a, 2010b; Ottenbreit-Leftwich et al., 2010; Overbay et al., 2011). Figure 2 maps the factors identified in the literature review into a conceptual framework. The arrows drawn on the conceptual framework indicate the connections among the factors influencing how teachers integrate and implement technology in the classroom, as supported by empirical findings. The review of research literature has shown that leaders addressing certain factors will allow teachers to integrate technology more fully (Buckenmeyer, 2010; Ertmer et al., 2012; Hsu, 2016; Inan & Lowther, 2010a, 2010b; Lowther et al., 2012). As illustrated in the conceptual framework (Figure 2), beliefs and confidence were interconnected and could influence the success of teachers with integrating technology to support student learning.

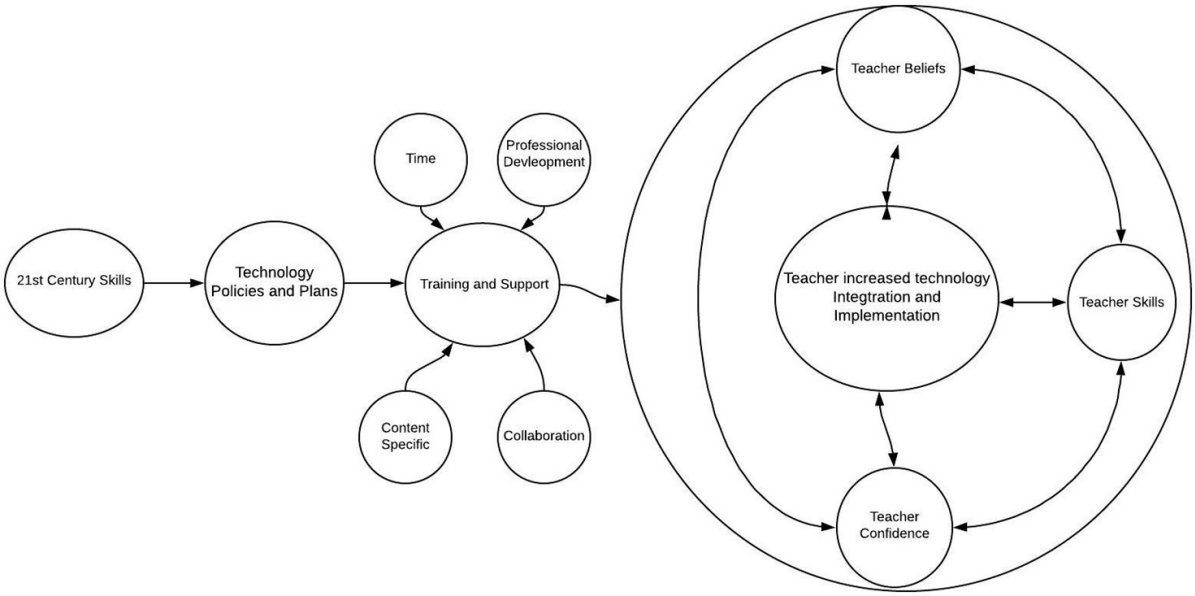

Figure 2. Problem of practice's conceptual framework.

The review of literature showed a problem remained with technology implementation and integration in the classroom. The key themes in technology integration and implementation included support, training, and time for teachers to build their technology skills and confidence levels (An & Reigeluth, 2011; Ertmer et al., 2012; Hughes, 2005; Inan & Lowther, 2010a, 2010b; McLeod et al., 2015; Mouza, 2009; Pittman & Gaines, 2015; Vannatta & Fordham, 2004). Building teachers' beliefs and confidence levels can positively impact teachers' integration and implementation of technology. As described In Chapter 2 a needs assessment was conducted to review the following identified factors tied to technology implementation and integration: technology training, technology support, teacher beliefs, and teacher confidence.

Chapter 2: Assessing Teachers' Needs for Technology Implementation and Integration

Technology implementation and integration is a process where teachers navigate multiple factors. The literature research showed the following factors as influencing technology implementation and integration: teachers' confidence, teachers' beliefs, technology support, technology training, technology policies and plans, and 21st century skills (Buckenmeyer, 2010; Ertmer et al., 2012; Hsu, 2016; Inan & Lowther, 2010a, 2010b; Lowther et al., 2012). Some researchers found that more time, support, and PD were needed to build teachers' beliefs, skills, and confidence with technology integration (Ertmer et al., 2012; Inan & Lowther, 2010a, 2010b; Mouza, 2009). Through the following needs assessment, these factors were explored further to understand better which had the greatest effect on successful technology integration. Developing a better understanding of the factors affecting technology integration can be used to strengthen support for teachers implementing and integrating technology.

Context of Study

The context for the POP was the Ocean School District (a pseudonym), a public school district in the southeastern United States in the process of implementing a 1:1 Chromebook initiative for all third- through eighth-grade students. Leaders of the 1:1 initiative supplied students with a Chromebook, case, power charger, and computer bag that they could bring to and from school each day. Prior to this study the initiative was in place for two years across 25 elementary schools and 11 middle schools. In kindergarten to second grades, teachers received different types of technology, including several iPads and Chromebooks, to use in their classrooms. Ocean School District had an instructional technology department with seven technology coaches each assigned to work with six to seven schools. Coaches visited each of their assigned schools once a month, supporting technology integration. The technology

department had another division that monitors and maintains networks, hardware, software, and technology devices. The district permitted each school to determine technology implementation while providing a school district technology plan to guide those efforts. The target population identified for the needs assessment included kindergarten through eighth-grade teachers at three schools in Ocean School District provided with district technology.

Statement of Purpose

The purpose of the needs assessment study was to investigate how teachers implemented and integrated the district-provided technology. In addition, the researcher examined if the factors identified in the literature were evident in the Ocean School District's teacher technology integration. Factors noted in the review of the research included teacher confidence, teacher beliefs, technology training, technology support, technology training, technology polices and plans, and 21st century skills (Buckenmeyer, 2010; Ertmer et al., 2012; Hsu, 2016; Inan & Lowther, 2010a, 2010b; Lowther et al., 2012). Understanding the underlying factors that teachers encountered with technology implementation and integration in the Ocean School District guided development of the needed intervention. The following research questions guided the study:

RQ 1: How are the teachers at Ocean School District using technology in their classroom?

RQ2: To what extent and to what types of technology support do teachers have access?

RQ3: How often and in what types of technology training do teachers report they have participated?

RQ4: What are teachers' technology skill and comfort levels?

Methodology

Research design. A needs assessment was conducted to identify the factors influencing technology implementation and integration to understand how teachers implemented and integrated the district-provided technology. A quantitative study was conducted. Data were gathered using a survey that included multiple-choice questions, checklists, Likert-scale questions, and one open-ended question.

Participants. The targeted population included kindergarten through eighth-grade public school teachers at three of the Ocean School District schools. School A was a kindergarten through eighth-grade school where the researcher worked. School B was an elementary school with kindergarten through fourth grade, and School C was a middle school with fifth grade through eighth grade. All three schools had iPads and Chromebooks for teachers and students to use in their classrooms. A total of 126 teachers in the three schools were invited to participate in the needs assessment. Of the 126 teachers, 61 (48%) teachers gave consent to participate. Most participating teachers taught third through eighth grade. Among those who participated, 54 were female teachers, six were male teachers, and one teacher did not select a gender. Table 1 shows a description of participants.

Table 1

Participants' Demographics as a Percentage of the Sample

Category	*n* (%)
Grade level taught*	
K-2	18 (23.6)
3-5	28 (37)
6-8	30 (39.4)
Highest level of education	
Bachelor	7 (11.5)
Bachelor +18	5 (8.2)
Masters	32 (52.5)
Masters +30	16 (26.2)
Doctorate	1 (1.6)
Years of teaching	
1-5 years	5 (8.2)
6-10 years	18 (29.5)
11-15 years	17 (27.9)
16-20 years	7 (11.5)
20+ years	14 (23)

Note. $n = 61$; *5 teachers teach multiple grade levels.

School A. School A was a kindergarten through eighth-grade school with 1,190 students and 70 teachers. The school provided kindergarten to second-grade teachers with several iPads per class and third- to eighth-grade students with 1:1 Chromebooks. The iPads remained at school, but students brought Chromebooks to and from school. For over a year at School A and during the needs assessment, teachers had access to an onsite instructional technology coach. This coach provided iPad and Chromebook training during faculty meetings throughout the school year. The coach also provided other forms of support in the classrooms daily, including developing and co-teaching technology-based lessons. Teachers and students also had access to a school-based technology assistant during the needs assessment. The technology assistant helped with onsite support in fixing problems that occurred with devices and technology infrastructures of the school. The technology assistant had direct access to district technical support and could fix technological problems with WIFI, software, and Chromebooks at a faster rate versus waiting for district technical support. Due to funding adjustments, the technology coach and assistant

positions were eliminated from School A at the end of the 2016 to 2017 school year. Beginning with the 2017 to 2018 school year, School A had a shared district instructional technology coach, like Schools B and C.

School B. School B was a kindergarten through fourth-grade elementary school, with 339 students and 23 teachers. School B provided third- to fourth-grade students with 1:1 Chromebooks that students could take to and from school. The kindergarten to second-grade students could participate in 1:1 Chromebooks if the teacher elected to do so. During the needs assessment, the information on how many teachers elected to use the technology was unavailable. A shared instructional technology coach was provided to School B, with the coach's time divided with several other schools in the district. The instructional technology coach came to School B once a month. Teachers could email the coach anytime they needed help or had questions about the technology.

School C. School C was a middle school that housed Grades 5 through 8, with 272 students and 19 teachers. School C provided fifth- to eighth-grade students with 1:1 Chromebooks that students could take to and from school. As with School B, a district instructional technology coach was available for once-a-month visits to aid teachers with implementing the technology and troubleshooting other technological issues.

Measures and instrumentation. This section describes the measures and instrumentations used in the study. Teachers received the Investigating the Use of Technology by Teachers online survey through a Google form (Appendix A). The 28-item survey was designed to only take 20 minutes to complete. The researcher compiled the survey by using questions from other surveys in the literature review (An & Reigeluth, 2011; Pittman & Gaines, 2015; Ruggiero & Mong, 2015; Vannatta & Fordham, 2004). The researcher created the survey; thus, the

following experts reviewed the survey: the School A technology coach, the researcher's advisor, and a Johns Hopkins' professor. The survey items were updated based on the feedback provided, and several questions were refined for clarity.

The survey was used to measure whether the factors in the Chapter 1 review of the research on teacher beliefs, teacher confidence, technology support, and technology training were evident with this population. The first section of the survey included six multiple-choice demographic questions, including highest level of education, years of teaching experience, and grade levels currently teaching (see Table 1). The second section measured the levels of participants' knowledge about technology usage comprised of questions from the surveys in An and Reigeluth (2011), Pittman and Gaines (2015), Ruggiero and Mong, (2015), and Vannatta and Fordham (2004). The six multiple-choice questions and three checklist questions in this section (for a total of nine questions) focused on technology usage by teachers and students in the classroom to address RQ1.

The third section, training and comfort level, consisted of 13 questions. Of the seven questions in this section, three used a 5-point Likert scale, ranging from *not important* to *extremely important*. Also included were an open-ended question, two checklists, and three multiple-choice questions. The questions focused on support, training, comfort, and skills to address RQ2, RQ3, and RQ4.

Participant recruitment. The researcher sent an emailed invitation to 126 teachers in Spring 2017. The only requirement to take part was that the participant be a teacher at one of the three schools. The email explained the needs assessment and contained a link to the survey (Appendix B). The first page of the survey was the letter of informed consent. If the participant agreed to take part in the survey, the Google form moved the participant to the first part of the

survey. Because the survey was created as a Google form, the participants' answers automatically populated a Google spreadsheet.

Data collection. Quantitative data were collected using the following survey: Investigating the Use of Technology by Teachers. The survey was kept open for two weeks in Spring 2017. Once participants took the survey, data were automatically compiled into Google spreadsheets and stored in the researcher's password-protected Google drive. All data were recorded anonymously with a number assigned to each participant. Once all the data were collected, the researcher analyzed these data.

Data analysis. Quantitative analysis occurred through descriptive statistics for the data collected, including central tendency, standard deviation, and frequency. The researcher made sense of the data by organizing and summarizing the data collected through the survey while analyzing the data using descriptive statistics (O'Leary, 2014). Descriptive statistics were used as the data analysis in each of the studies used to develop the survey used in the needs assessment (An & Reigeluth, 2011; Pittman & Gaines, 2015; Ruggiero & Mong, 2015; Vannatta & Fordham, 2004). Descriptive statistics were used to quantify technology usage, support, training, teacher skills, and teacher comfort. The frequency was used to determine how technology was used, what supports teachers reported for using said technology, teachers' technology skill levels, and how comfortable teachers were using the technology.

Findings

Research Question 1. How are the teachers at Ocean School District using technology in their classroom? The researcher analyzed Section 3 questions finding that teachers in the Ocean School District reported they and their students used technology in the classroom in varied ways. Of the 61 teachers participating in the 1:1 Chromebook initiative, 55 used technology in their

classrooms daily. Table 2 shows the frequency of responses related to types of technology used. The technologies with the highest reported frequencies included videos, Smartboards, and computers.

Table 2

Technology Used in the Classroom

Technology Use	Frequency	Percentage %
Videos (YouTube)	60	98.4
Smartboard	58	95.1
Computer (Desktop/Laptop)	57	93.4
E-mail	56	91.8
Google Drive/Microsoft Office	56	91.8
Google Classroom	51	83.6
Chromebook	49	80.3
Projector, ELMO, Ladybug	45	73.8
Smartphones	22	36.1
I-Pad	21	34.4
Digital and Video cameras	17	27.9
Other: Vernier probes	2	3.3
Other: Virtual Reality Kit	1	1.6
Other: 3D printer	1	1.6

Teachers were also asked how their students used technology to learn. Teachers indicated multiple ways that their students used technology (see Table 3). The top four reported included creating projects, doing research, participating in student-centered approaches to learning, and watching videos.

Table 3

Frequency of How Students Used Technology in the Classroom

How technology is used	Frequency	Percentage %
To create projects	44	72.1
To research	43	70.5
To participate in student centered approaches to learning	40	65.6
To watch videos	39	63.9
To write papers	30	49.2
To collaborate with peers	29	47.5
To take notes	23	37.7
Other: reading and math practice	4	6.6
Other: interactive lectures	1	1.6
Other: Mastery Connect	1	1.6
Other: online textbook	1	1.6
Other: online activities	1	1.6
Other: write music	1	1.6
Other: IEP goals/targets	1	1.6

Research Question 2. To what extent and to what types of technology support do teachers have access? The researcher analyzed Section 3 questions, Likert-Scale Questions 21 to 22, and open-ended Question 23, finding that teachers had access to support and felt supported when using technology in their classrooms. Twenty-six participants indicated that support was extremely accessible, with none reporting difficulty in accessing support (see Table 4). When asked how supported they felt when using the provided technology, 28 participants reported extremely supported. Teachers believed support was provided and accessible (see Table 4).

Table 4

Level of Support

Question	1	2	3	4	5
21. How accessible is support for implementing and troubleshooting the technology you use?	0 (0%)	4 (6.6%)	13 (21.3%)	18 (29.5%)	26 (42.6%)
22. How supported do you feel with using the provided technology in your classroom?	1 (1.6%)	5 (8.2%)	5 (8.2%)	22 (36.1%)	28 (45.9%)

Note. 21. 5-point Likert scale is 1 (*difficult to access*) to 5 (*extremely accessible*); 22. 5-point Likert scale is 1 (*not supported at all*) to 5 (*extremely supported*).

Breaking down the results further, Question 23 (open-ended question) asked participants if they felt support, who or what supported them. Table 5 shows a breakdown of the responses given to who or what supports teachers with technology. Of the participants who responded (n = 47), 26 identified the technology coach as the person providing them with support. The next highest frequency indicated colleagues helped teachers with support.

Table 5

Who or What Supports Teachers With Technology

Type of support	Frequency	Percentage %
School A Technology coach	26	55%
Colleagues	9	1.9%
District technology coach	8	1.7%
District technology office	7	1.5%
School A Technology assistant	4	0.8%
Curriculum coach	3	0.6%
Principal	2	0.4%
District training	1	0.2%
School	1	0.2%

Note. $N = 47$.

Research Question 3. How often and in what types of technology training do teachers report they have participated? Results from the survey indicated that all participants took part in at least one type of technology training in the 2017 to 2018 school year. Half of the teachers (32) reported taking part in two trainings, six took part in more than two trainings, while an additional nine took part in monthly trainings throughout the 2017 to 2018 school year. When participants checked what type of technology training that they would prefer, 40 of teachers indicated that an onsite technology coach school would be beneficial to the school for providing on campus trainings (Table 6). A few teachers checked "Other" and wrote in their choices, including technology training provided by the school district, time to collaborate in professional learning communities (PLCs), and PD. When participants were asked their training preferences, 26 chose hybrid training.

Table 6

Types of Technology Training That Teachers Want

Type of training	Frequency	Perecent
Technology coach assigned specifically to your school	40	65.6
Professional development provided by district or school	30	49.2
Time to collaborate in PLCs	29	47.5
Training occuring monthly or weekly throughout the school year	15	24.6
Technology cohort lasting a semester long	9	12.8
Other: from the manufacturer of the programs	1	1.6
Other: time for mentoring or modeling	1	1.6

Research Question 4. What are teachers' technology skill and comfort levels? Most participants (80.3%) identified with having skills and being comfortable with technology but still saw room for growth (see Table 7). The findings of teacher technology skills showed that 16.4% of participants identified with being experts on using technology (Table 7). The data indicated that the teachers were moderately comfortable and skilled with using the technology but still had room for growth.

Table 7

How Comfortable and Skilled

Question	1	2	3	4	5
18. How comfortable are you in creating technology rich lessons for your students?	2 (3.3%)	3 (4.9%)	15 (24.6%)	21 (34.4%)	20 (32.8%)
20. How skilled or comfortable are you with using the provided technology?	1 (1.6%)	1 (1.6%)	10 (16.4%)	39 (63.9%)	10 (16.4%)

Note. 18. 5-point Likert scale is 1 (*not comfortable at all*) to 5 (*extremely comfortable*); 20. 5-point Likert scale is 1 (*not understanding at all of using technology*) to 5 (*expert on using technology*).

Discussion

The purpose of the needs assessment was to understand how teachers in the Ocean School District implemented and integrated technology to determine if any of the factors uncovered in the literature review were found evident in the Ocean School District. The factors

found evident in the Ocean School District's findings from this needs assessment included technology usage, teacher skills, teacher comfort, technology support, and technology training. The researcher determined that teachers implemented the district provided technology but did not integrate the technology. Researchers defined technology implementation as having access to and using technology (Lu & Overbaugh, 2009; Pittman & Gaines, 2015); similarly, this needs assessment showed that teachers implemented technology and had students use technology for learning purposes. The findings were like those of Ruggiero and Mong (2015) who found that teachers implemented technology but needed more opportunities for learning how to integrate technology. The researchers suggested teachers would step further into integrating technology in their classrooms by being given opportunities, such as from PDs, on how to use the technology in ways that students would engage in deeper learning through technology (Ruggiero & Mong, 2015).

These results showed that teachers used technology in their classrooms for teaching their students. Students used the district-supplied technology for teacher-directed research and project work, which was implementation level; however, teachers indicated they created integrated lessons. Participants were not asked to define integrated lessons, and the findings did not show if their definition met the following research definition: incorporating technology confidentially and successfully into the curriculum daily to support students' learning (Pittman & Gaines, 2015). The teacher participants in the needs assessment may need training on defining technology integration. The findings from the Ocean School District teachers were supported in several of the studies in the literature review that showed that teachers needed further training on technology integration (An & Reigeluth, 2011; Lowther et al., 2012; Palak & Walls, 2009;

Ruggiero & Mong, 2015). Further data should be collected to understand better how participants define technology integration to inform and understand how teachers use technology.

The needs assessment showed that teachers took part in technology training at some point throughout the school year and would like future training through a hybrid of virtual and in-person training. A limitation of the survey was participants could only select one response for how many technology trainings they took part in the school year. Teachers preferred support through an in-house technology coach. Teachers further indicated that colleagues and district technology coaches were valuable avenues of support. This finding was significant because collaboration with colleagues and experts was found as a subfactor of support that had a positive effect on fostering technology implementation and integration (see An & Reigeluth, 2011; Buckenmeyer, 2010; Lowther et al., 2012; McLeod et al., 2015; Mouza, 2009; Ritzhaupt et al., 2008). The results also showed a disparity between the support teachers felt and the accessibility of that support. School A, with an in-house technology coach and assistant at the time of the needs assessment, had easier access to support than Schools B and C.

Reviewing the findings of teacher technology skills and comfort levels, most teachers had technology skills and were moderately comfortable with using technology. Without more data and details, the researcher could not conclusively determine the degrees of teachers' technology skills and comfort levels. The limitations of the needs assessment included time constraints and inexperience of the researcher in conducting a needs assessment. The researcher created a survey built from other surveys found in the literature, resulting in a measure that lacked reliability and validity. Another limitation entailed using the word comfort on the survey instead of technology confidence, which was identified in the review of literature. Although these limitations influenced the needs assessment, the results showed teachers implemented technology but could

grow in technology integration. Future researchers can analyze for gender, grade level, and school location. Only six of the participants were male; thus, the researcher did not compare gender in the analysis. The survey was not detailed enough for comparison of grade levels because there were only ranges: K–2, 3–5, and 6–8.

In Chapter 3, an intervention literature review was conducted to identify ways to support teachers in technology integration. The needs assessment showed that teachers implemented the provided technology. Thus, the next step was to find ways to build teachers' technology beliefs and confidence through support and training to foster technology integration. Teachers at all three schools indicated preferences for having an in-house technology coach; however, this option was unavailable. Thus, the researcher explored how to sustain supports, resources, and training that an in-house technology coach could provide in expanding teachers' technology integration in the following chapter.

Chapter 3: Supporting Technology Integration: Intervention Literature Review

The needs assessment in Chapter 2 showed that teachers in the three Ocean School District schools used technology in their classrooms on an implementation level and had not yet reached integration of technology into daily lessons. Teachers in the Ocean School District should move from technology implementation to technology integration. The needs assessment showed the main themes for building teachers technology integration skills and confidence which included collaboration, more time for training, and support. A review of literature was conducted to identify types of interventions that could support deeper technology integration in the Ocean School District to move from mere technology implementation, tailoring approaches to teachers' preferred method of technology training and support. The interventions reviewed included PDs, informal learning, PLCs, and CoPs (Duncan-Howell, 2010; Ho & Yao, 2018; Hsu & Sharma, 2008; Keengwe & Onchwari, 2009; Vavasseur & MacGregor, 2008). The researcher focused on interventions that would create technology support and resources to increase teachers' technology skills and confidence while fostering technology integration.

Theoretical Framework

Constructivism was the theoretical framework used for the identified intervention because constructivists view "knowledge as being individually constructed and unique to each person" (Richey, Klein, & Tracey, 2011, p. 187). Learners can use a constructivist approach to build current knowledge from pre-existing knowledge and personal learning experiences (Ernest, 2010). Taking a constructivist approach to technology integration develops an environment for learners that can expand beyond the classroom and include enhanced learning opportunities (Pittman & Gaines, 2015). Research has shown that teachers learn to use the technology in their environments through their curriculums aligning with a constructivist approach to use and

integrate technology (Keengwe & Onchwari, 2009; Pittman & Gaines, 2015). The constructivist learning theory, which emerged from the cognitive learning theory of Piaget, Bruner, and Goodman (Ertmer & Newby, 1993), was developed "based on the premise that we all construct our own perspective of the world, through individual experiences and schema" (Schuman, as cited in Mergel, 1998, p. 2). Von Glasersfeld (2005) connected Piaget's work with a constructivist approach, explaining that knowledge was gained through learners' actions and reflections. The environment of the learner and finding meaning in the learning are key to a constructivist approach to gaining knowledge. In a constructivist approach, learners gain knowledge through pre-existing knowledge, interactions, experiences, and reflections within their environments (von Glasersfeld, 2005). The researcher chose this theoretical framework based on the findings of the needs assessment: Teachers had pre-existing knowledge about technology and indicated preferences for learning through interactions and experiences relevant to their professional environments.

Learners process knowledge using prior knowledge but, as Ertmer and Newby (1993) explained, they are not taking knowledge from the external world. Instead, they are building personal interpretations from their experiences. In a constructivist approach, learning occurs through the interactions of creating meaning through experiences instead of learning the knowledge in isolation (Ertmer & Newby, 1993; von Glasersfeld, 2005). Both the learner and environment are considered when using a constructivist theory. Ertmer and Newby (1993) explained that a constructivist approach to learning occurred when the task, technology integration, was relevant to the learner and occurred in the learner's environment: the teacher's classroom. An intervention using a constructivist approach that provides models, supports, and scaffolding of experiences can provide teachers with the knowledge to build their skills and

confidence as they integrate technology in their curriculums (Doering et al., 2014; Keengwe & Onchwari, 2009; Unger & Tracey, 2013).

Connectivism is a newer learning theory connected to technology learning developed to understand better how digital learning can expand learning (Gerard & Goldie, 2016; Siemens, 2004). Like constructivism in a connectivism approach learning occurs through learners' networks and experiences (Chandrappa, 2018; Gerard & Goldie, 2016). With connectivism, learning does not always occur in a traditional way but opens opportunities for informal learning through technology and the Internet (Gerard & Goldie, 2016). For learning to occur, people need to have the right connections, people, and contexts to allow the knowledge to flow (Siemens, 2004). A connectivist approach uses informal learning, 21st century learning, multiple learning platforms, technology, and collaboration to build networks for learners (Chandrappa, 2018; Gerard & Goldie, 2016; Siemens, 2004). Using both the constructivist and connectivist approaches to learning as a framework for the intervention at Ocean School District enabled the teachers to expand their professional networks of support and resources to build their technology integration skills and confidence levels.

Review of Literature

Teachers need the skills and confidence to integrate technology (Klieger, Ben-Hur, & Bar-Yossef, 2010). One should recognize that just having the technology does not mean that it will have a positive influence on student learning or technology integration (Keengwe & Onchwari, 2009). This literature review is organized by possible interventions that may build teachers' technology skills and confidence through supports, resources, and collaborations (Duncan-Howell, 2010; Ho & Yao, 2018; Hsu & Sharma, 2008; Keengwe & Onchwari, 2009; Vavasseur & MacGregor, 2008).

Professional development. PD refers to "experiences that take place within a collaborative culture of shared leadership, that increase educators' knowledge about content and pedagogy and enable them to use that knowledge to improve classroom and school practices that improve student learning" (Swan et al., 2014, p. 44). Leaders of successful PD focus on giving teachers the tools and skills to incorporate technology into the curriculum (Doering et al., 2014; Keengwe & Onchwari, 2009). In a mixed-method convergent parallel design study, Doering et al. (2014) focused on teacher experiences of a technology, pedagogy, and content knowledge PD program. Twenty middle and high school teachers took part in a week-long PD focused on technology integration and content knowledge. The learning included hands-on experiences with creating technology-infused assessments, lesson plans, and web-based applications related to teachers' content areas (Doering et al., 2014). Data were collected quantitatively through pre- and post-surveys, and open-ended questions in the survey provided qualitative data. The results were analyzed using descriptive statistics for the quantitative data and grounded theory for the qualitative data. The participating teachers found benefits in technology integration, including student engagement and authentic learning (Doering et al., 2014). Participants indicated that using instructional scaffolding with technology integration and pedagogy application through the PD helped them address technology barriers (Doering et al., 2014). The researchers concluded that PD built around teacher pedagogy and content knowledge could increase teachers' abilities to integrate technology into their curriculums.

Using a constructivist approach, Keengwe and Onchwari (2009) implemented a summer institute. Twelve early childhood teachers participated in exploring various technology integration strategies using online resources, instructional tools, and software resources. Through workshops, trainings, lesson development, and hands-on activities, the PD provided teachers

with opportunities to become more comfortable with the technology (Keengwe & Onchwari, 2009). Data were collected through technology-based projects that teachers completed during the summer institute and then analyzed by a rubric created by Keengwe and Onchwari (2009). The projects included the content that teachers taught and applied to the technology they learned about in the PD (Keengwe & Onchwari, 2009). The created products showed that through the PD, teachers gained access to tools and resources that built their skills for using and integrating technology (Keengwe & Onchwari, 2009). Keengwe and Onchwari (2009) showed that PD could effectively be used to provide teachers with opportunities to try resources and learn how technology worked. Even though Doering et al. (2014) worked with middle and high school teachers and Keengwe and Onchwari (2009) worked with elementary teachers, both concluded that a longer PD focused on technology integration with content connections had positive effects on building teachers' confidence with technology integration. Like Doering et al. (2014) and Unger and Tracey (2013), smaller participant numbers in the PD make it harder to generalize the findings.

In a qualitative multiple case study by Unger and Tracey (2013), secondary education teachers took part in a technology online PD intervention built with a constructivist design. The purpose of the study was to examine what factors teachers perceived as most beneficial with technology PD (Unger & Tracey, 2013). The participants included five high school teachers in Michigan. The virtual PD occurred over the course of five weeks during the summer. Participants were asked to design instructional materials for integration in their classrooms, thus creating an opportunity for the teachers to use this experience in an authentic manner (Unger & Tracey, 2013). Data were collected through guided reflective journal entries where participants reflected on the how and why of the lessons (Unger & Tracey, 2013). The results were

qualitatively analyzed in four stages: preparing data, familiarizing oneself with data, coding the data, and generating meaning from the data (Unger & Tracey, 2013). Unger and Tracey (2013) found several beneficial factors that should be used when creating a technology PD: relevance of the content, access to the resources, interactions with colleagues and instructor, and clarity of the learning objectives. The accessibility factors included technology and instructional resources for teachers (Unger & Tracey, 2013). Interactions included modeling and feedback from the instructors of the PD, as well as collaboration with colleagues (Unger & Tracey, 2013). PD sessions relevant to the participants could create opportunities for the technology to be integrated into the curriculum and pedagogy (Unger & Tracey, 2013). Unger and Tracey (2013) and Keengwe and Onchwari (2009) reached similar findings with a constructivist approach that included technology integration relevant to how teachers use the technology connected to their curricula.

Leaders of PD need to keep content relevant to teachers by considering their content areas and learning environments (Klieger et al., 2010; Kopcha, 2012). Leaders creating meaningful examples in technology PD can give teachers insights on how to develop successful technology-integrated lessons. Kopcha (2012) conducted a case study using 18 elementary teachers and examined how the teachers perceived technology integration after participating in a two-year situated PD. Leaders of the situated PD, given in the context of participants' environments, focused on technology integration that included mentoring and CoPs (Kopcha, 2012). Data were collected over the two years with a researcher-designed Technology Integration Survey, interviews, and lesson observations. The results were analyzed using a longitudinal single case study design, where data were considered across teachers instead of by each case (Kopcha, 2012). Descriptive statistics were used for the quantitative data, and

inductive analysis was used for the qualitative data. The results showed that situated PD could change teachers' perceptions of technology integration factors (Kopcha, 2012). The teachers who participated in the situated PD collaborated with peers in their schools and during teacher team meetings to support integrating technology (Kopcha, 2012). Keengwe and Onchwari (2009) and Unger and Tracey (2013) conducted similar case studies about making the PD relevant, providing access to resources, and utilizing collaboration with colleagues. Kopcha (2102) found no changes with the time it took to integrate the technology. Participants still identified time as a barrier to technology integration, even after taking part in the situated PD (Kopcha, 2012).

Like Kopcha's (2012) two-year study, Brinkerhoff (2006) examined a two-year program of PD used for teachers to develop technology skills, computer self-efficacy, technology beliefs, and technology practices. Participants consisted of 23 elementary teachers and two secondary education teachers. Data were collected through the Technology Beliefs and Competencies Survey (Brinkerhoff, Ku, Glazewski, & Brush, 2002) and individual interviews (Brinkerhoff, 2006). The researcher only used the survey data from the 12 participants who took part over the two years. The results were reviewed quantitatively through analysis of variance and qualitatively through thematic analysis. Due to the small sample size, Brinkerhoff (2006) noted that the validity of statistical analysis was a limitation. Brinkerhoff found that the participants in the PD increased their technology skills and confidence in using technology, having more positive attitudes about technology integration than before. In this long-term PD, Brinkerhoff recognized that extended time and a hands-on approach were needed to build teachers' technology skills successfully. Brinkerhoff (2006), Keengwe and Onchwari (2009), and Unger and Tracey (2013) used constructivist approaches so that teachers could build their prior

knowledge and experiences through new experiences with technology resources that they could then successfully apply in their classrooms.

In reviewing PD studies, common themes emerge for improving teachers' technology skills, technology confidence, and technology integration. Researchers of workshops or extended PD found a greater chance of increasing technology integration by building teachers' technology skills (Brinkerhoff, 2006; Duncan-Howell, 2010; Kopcha, 2012; Unger & Tracey, 2013). Leaders of PDs who had success with increasing technology skills, creating technology confidence, and developing technology integration strategies were longer than a day, relevant to the audience, and hands-on (Brinkerhoff, 2006; Doering et al., 2014; Keengwe & Onchwari, 2009; Kopcha, 2012; Unger & Tracey, 2013). Thus, long-term PD is more successful with increasing teachers' technology knowledge and skills than a single session PD (Brinkerhoff, 2006; Kopcha, 2012; Unger & Tracey, 2013). A constructivist approach to learning to supports a PD intervention that includes hands-on opportunities, remains relevant to the teachers' context, and occurs over a length of time. Informal learning is also helpful to PD, as discussed in the following subsection.

Informal learning. Informal learning refers to "any activity involving the pursuit of understanding, knowledge or skill which occurs without the presence of externally imposed curricular criteria" (Livingstone, 2001, p. 4). Teachers can use social networking websites for easy access, collaboration, and the ability to embed web tools. Web tools include chats, blogs, and Wikis in an informal learning environment. Teachers can use informal online communities as voluntary ways of engaging with colleagues through shared learning, reflection, and support (Macià & García, 2016). Siemens (2004) developed the connectivism learning approach and explained that informal learning occurres in a variety of ways, enhanced by technology.

Researchers wrote an ISTE white paper about how to design and support technology integration. The researchers from ISTE recommended using a methodology of effective coaching models, online communities, and integrated technology (Beglau et al., 2011). Additionally, researchers of ISTE recommended learning should occur in the context of the learner through social media tools, video communications, and blogs (Beglau et al., 2011). Being a part of an online community creates real-time support, access to resources and tools, and social network opportunities for personal growth (Beglau et al., 2011). Greenhow and Askari (2017) reviewed educational research about social networking sites and the impact on how teaching and learning occurred over the past decade. A social network site refers to "web-based services through which individuals can maintain existing ties and develop new social ties with people outside their network" (Greenhow & Askari, 2017, p. 625). Social networking sites align with the constructivist theory by providing teachers the opportunity to learn through collaboration, connections, and networking (Greenhow & Askari, 2017). Through a social network platform, informal learning occurs daily, where teachers can access a platform for networking, sharing, and collaboration to occur, also connected with a connectionist approach to learning (Greenhow & Askari, 2017; Siemens, 2004). In informal learning, there is no set time for when learning occurs, and an online platform allows for frequent exchanges.

Informal learning is a voluntary way for teachers to engage with their colleagues to share resources and support each other with technology implementation (Macià & García, 2016). Song and Bonk (2016) examined learners' motivational factors and self-directed learning using an online survey given to participants on researcher-identified informal learning websites. The participants included 85 people using informal learning websites, such as virtual education, educational resources, and global education (Song & Bonk, 2016). Data were collected through

an online survey. The results were analyzed with descriptive statistics based on frequency. Song and Bonk (2016) found three common themes that motivated learners using informal learning: freedom and choice, control, and interest and engagement. The participants located most resources through social networks or colleagues using a connectionist approach to learning, meaning that teachers built their own learning networks (Gerard & Goldie, 2016). As in the PD studies by Kopcha (2012), Keengwe and Onchwari (2009), and Unger and Tracey (2013) that found that participants lacked the time to work with technology, Song and Bonk (2016) noted the same barrier. The other barriers found included membership fees and lack of quality online resources (Song & Bonk, 2016).

In an ethnographic study, Rashid, Yahaya, Rahman, and Yunus (2016) examined how teachers used informal learning, through social networks, for their PD. The participants included 22 English teachers who were observed for how they engaged on Facebook over six months (Rashid et al., 2016). Data were collected through observations of each participant's timeline conversations on Facebook and informal conversations. Qualitative data were analyzed through ethnographic coding. Data analysis indicated that five types of teacher knowledge were observed, with content knowledge most frequently exchanged (Rashid et al., 2016). Greenhow and Askari (2017) and Rashid et al. (2016) indicated that social network platforms might help teachers engage in informal learning about technology integration. Although Song and Bonk (2016) used a survey to measure informal learning and Rashid et al. (2016) used observations, both found that using social networks resulted in teachers building their technology integration knowledge through informal learning.

In a similar study to Rashid et al. (2016), Kamalodeen and Jameson-Charles (2016) examined how teachers participated in online social networking websites. The participants

included 35 secondary school teachers. Data were collected through an online questionnaire, interviews, Google Analytics, and digital talk on the websites (e.g., blogs and Wikis). Data were analyzed quantitatively and qualitatively through descriptive statistics, coding, tallying, and discourse analysis. Kamalodeen and Jameson-Charles (2016) identified participants' activities on social networking websites using the following labels: content consumer, those who pick up content but do not contribute; window-shopper, those who visit but do not interact; content producer, those who share resources they have created; collaborator, those who work with other participants on created resources; and leader, those who mentor, collaborate, and take risks. The results indicated that most participants were content consumers where they preferred to view or use the content on the sites (Kamalodeen & Jameson-Charles, 2016). The benefit of the online social networking websites was in knowledge consumption; participants learned new things from each other, gave advice, connected with each other, and shared their experiences with colleagues (Kamalodeen & Jameson-Charles, 2016). The results also indicated barriers included motivation and usability of the site (Kamalodeen & Jameson-Charles, 2016). Like Song and Bonk (2016), Kamalodeen and Jameson-Charles (2016) found not having enough time as a factor for teachers participating on social networking sites.

Teachers can use a social networking site as an informal learning approach by creating a space for them to share, collaborate, network, and gather resources (Greenhow & Askari, 2017; Kamalodeen & Jameson-Charles, 2016; Rashid et al., 2016; Song & Bonk, 2016). Researchers showed that informal learning sites and social networking sites provided teachers with opportunities for sharing, networking, and collaborating, which taught them technology integration supports, resources, skills and confidence (Greenhow & Askari, 2017; Kamalodeen & Jameson-Charles, 2016; Rashid et al., 2016; Song & Bonk, 2016). Of central importance in all

the informal learning studies was the creation of learning opportunities for teachers without the need for formal PD that aligned with a connectivist approach to learning. Because teachers of informal learning can use an online platform on their own time, they can gather relevant resources and opportunities, supporting the constructivist and connectivist frameworks for learning (Chandrappa, 2018; Ertmer & Newby, 1993; Gerard & Goldie, 2016; Siemens, 2004; von Glasersfeld, 2005).

Professional learning communities. PLCs are created to promote peer collaboration, access to resources, and support. Researchers have defined a PLC as a group collaborating to achieve a common goal, sometimes with a facilitator guiding the process (McConnell, Parker, Eberhardt, Koehler, & Lundeberg, 2013). PLCs can be conducted through a variety of formats that include meeting face-to-face, meeting online, or meeting through a mix of both (i.e., a blended model). PLCs can be utilized to provide long-term PD and afford teachers the opportunity to build their technology skills and confidence in building technology integration (Booth & Kellogg, 2015; McConnell et al., 2013; Vavasseur & MacGregor, 2008). Brinkerhoff (2006) and Kopcha (2012) found that over time, expanded PD would be beneficial to teachers, helping them build their technology integration curriculums. When creating a PLC, the leader considers the content to be addressed, needs of teachers, methods of delivery, and authentic connections to the learner (Duncan-Howell, 2010; Ertmer & Newby, 1993). Making the content relevant allows teachers to remain engaged in authentic learning, connecting with the constructivist approach to learning (Duncan-Howell, 2010).

Teachers may take part in a PLC through face-to-face interactions, where teachers meet in person with their colleagues. Researchers have suggested that including face-to-face PD can increase collaboration, access to resources, and support (Booth & Kellogg, 2015; Vavasseur &

MacGregor, 2008). McConnell et al. (2013) conducted a comparative case study and examined teachers' experiences in an online PLC versus meeting in person. Participants consisted of 54 teachers who met once a month in 11 PLCs. Teachers from two of the PLCs met online, while teachers from nine of the PLCs met in person. Data were collected from video conference recordings, focus groups, and reflections from the participants. The results were analyzed through a constant comparative method to find the similarities and differences between the online and face-to-face PLCs (see McConnell et al., 2013). The results indicated that the participants in both online and face-to-face PLCs had similar benefits, including collaboration, accountability, professional friendships, and need to share evidence and solutions (McConnell et al., 2013). Through focus groups, McConnell et al. (2013) found that participants in the virtual group preferred in person, but online PLCs were considered an effective alternative because both groups had similar benefits. The results confirmed that when teachers faced time and distance barriers, online PLCs were effective (McConnell et al., 2013).

An online community, which can be synchronous or asynchronous in nature, may give teachers access to resources and experts they might not have access to otherwise (Booth & Kellogg, 2015). Booth and Kellogg (2015) analyzed online communities to understand the value provided to teachers. Twenty-five participants from four online communities took part in in-depth interviews (Booth & Kellogg, 2015). Analysis of the data occurred through an a priori coding scheme to identify themes. The results indicated that participants gained confidence in sharing with their colleagues, making social connections, learning both informally and formally, and applying their new knowledge in their classrooms (Booth & Kellogg, 2015). Booth and Kellogg (2015) found that, through online PLCs, teachers could collaborate and converse with peers to expand their professional networks.

In a study of three online PLCs with 98 members, Duncan-Howell (2010) used a survey to examine teacher experiences, attitudes, and skills in participating in online PLCs. Teacher participants in the PLCs explained how useful presented strategies were in helping them adopt new ideas for implementation in their classrooms (Duncan-Howell, 2010). The teachers participated in the PLCs because of their schools' professional requirements and for the emotional support offered (Duncan-Howell, 2010). The results indicated that most teachers spent one to three hours participating in the online PLC weekly. The asynchronous parts of the PLCs allowed teachers time to think, reflect, and compose responses (Duncan-Howell, 2010). Like Booth and Kellogg (2015) and McConnell et al. (2013), Duncan-Howell (2010) found the advantages to online PLCs as including time and relevance. Teachers found online PLCs helped with time and distance because they could log on from anywhere and participate when it suited their schedules (Duncan-Howell, 2010; McConnell et al., 2013).

Through PLCs, teachers can increase their skills and confidence through access to resources and support. Booth and Kellogg (2015) and Duncan-Howell (2010) found that an online learning community helped with confidence levels, and teachers applied what they learned into their classrooms. Online and face-to-face communities create opportunities for teachers to collaborate, expand their PLCs, participate in discussions, and gain relevant resources to use in their classrooms (Booth & Kellogg, 2015; Duncan-Howell, 2010; McConnell et al., 2013). PLCs fit into the constructivist and connectivist frameworks because teachers can connect to the environment around them to build their learning experiences (von Glasersfeld, 2005).

Community of practice. Another type of intervention that relates to technology integration entails CoPs. Lave and Wenger (1991) defined CoPs as a group of professionals who work together, learn from each other, and grow professionally. Teachers can join CoPs as part of

a collaborative process for creating products used in their curriculums (Boschman, McKenney, & Voogt, 2014). Kafyulilo et al. (2014) used an embedded single case study to examine how teams of teachers working in CoPs developed their technology integration skills, confidence, and knowledge. The study was conducted with 12 secondary science teachers. The teachers were divided into three groups to form the CoPs and participated in an introductory workshop, technology integrated lesson design, lesson implementation, and lesson reflection (Kafyulilo et al., 2014). Data were collected through surveys, interviews, focus groups, and observations. The results were analyzed quantitatively through descriptive statistics and qualitatively through inductive and deductive coding. The results indicated that teachers' technology integration knowledge, skills, and confidence increased through their participation in the CoP (Kafyulilo et al., 2014). The CoP allowed teachers to strengthen their technology skills on topics related to the intervention, including strategies for designing and implementing technology integrated lessons (Kafyulilo et al., 2014). The CoP gave teachers the opportunity to share "knowledge, skills, experiences, and challenges faced" (Kafyulilo et al., 2014, p. 301). Kafyulilo et al. (2014) recommended to strengthen the CoP by providing participants with access to experts, online learning materials, exemplary lessons, and collaboration guidelines.

Similar to Kafyulilo et al. (2014), Boschman et al. (2014) also employed a multiple case study design to examine a CoP used to support three teams of nine kindergarten teachers in creating technology-rich learning environments. Data were collected from each team through interviews and observations of the collaborative design process to create a technology integrated curriculum (Boschman et al., 2014). Analysis of the data occurred through coding and identifying themes. Practical concerns, such as creating lessons, were found to be the main reasons for participants working in a CoP, but teachers' knowledge and skills also played a role

in their participation (Boschman et al., 2014). Even though Kafyulilo et al. (2014) worked with high school teachers and Boschman et al. (2014) worked with kindergarten teachers, both found that within a CoP, teachers developed lessons and instruction aligned with the curriculum while incorporating technology. Boschman et al. (2014) and Kafyulilo et al. (2014) indicated that teachers would benefit from having experts on using and integrating the technology in their CoPs. Overall, these findings show that teachers can collaboratively increase their technology skills and confidence while working with colleagues to develop lessons that integrate technology (Boschman et al., 2014; Kafyulilo et al., 2014).

Although Boschman et al. (2014) and Kafyulilo et al. (2014) used face-to-face CoPs, an alternative way is to conduct CoPs with an online platform. Teachers can use the online platform to access and learn on their own time, choosing how and what to learn (Song & Bonk, 2016). Teachers using an online platform can collaborate and participate in discussions, thus creating more meaningful shared experiences (Ertmer & Newby, 1993; Kamalodeen & Jameson-Charles, 2016). In a mixed-methods case study, Vavasseur and MacGregor (2008) collected data on 40 middle school teachers who took part in online CoPs. Data were collected through focus group interviews, observations of discussion posts, a teacher efficacy survey, and completion of technology integrated unit plans (Vavasseur & MacGregor, 2008). Data were analyzed quantitatively with statistical procedures and qualitatively with constant comparative analysis. Vavasseur and MacGregor (2008) found that online CoPs increased communication, collaboration, and reflection, similar to the results achieved through face-to-face CoPs (see Boschman et al., 2014; Kafyulilo et al., 2014). Vavasseur and MacGregor (2008) concluded that an online community might provide teachers with an opportunity to feel less isolated while establishing a peer-support system. These conclusions were in line with Kafyulilo et al.'s (2014)

recommendations that online learning, access to experts, and collaboration would strengthen CoPs. Boschman et al. (2014), Kafyulilo et al. (2014), and Vavasseur and MacGregor (2008) recommended that an online CoP should include a technology expert who could facilitate technical support, thought-provoking discussion prompts, motivation to teachers, and relevant resources.

Using a CoP as support for professional learning or as part of an intervention builds teachers' technology integration skills, confidence, and knowledge (Boschman et al., 2014; Kafyulilo et al., 2014). Teachers can share their skills, knowledge, and experiences with each other by collaborating through a CoP (Boschman et al., 2014; Kafyulilo et al., 2014; Vavasseur & MacGregor, 2008). Creating an online CoP may give teachers support, such as collaboration opportunities and access to experts, which they lack otherwise (Vavasseur & MacGregor, 2008). The referenced studies showed CoPs create opportunities for communication, collaboration, and reflection among teachers, which increased teacher technology skills, confidence, and knowledge in creating technology-integrated lessons (Boschman et al., 2014; Kafyulilo et al., 2014; Vavasseur & MacGregor, 2008). Both face-to-face and online CoPs were found supportive of collaborative technology integration curriculum design (Boschman et al., 2014; Kafyulilo et al., 2014; Vavasseur & MacGregor, 2008).

Summary

An intervention built around constructivist and connectivist approaches to learning, including models, support, resources, collaboration, and scaffolding of experiences, can provide teachers with the opportunity to build their technology skills and confidence while fostering technology integration (Booth & Kellogg, 2015; Ertmer & Newby, 1993; Kafyulilo et al., 2014; Siemens, 2004). Researchers have identified several interventions as possible ways to support

teachers in building their skills and confidence regarding technology integration. Leaders of PDs who use a hands-on approach and offer relevance to teachers are most effective in helping them with technology integration (Brinkerhoff, 2006; Kopcha, 2012). Both face-to-face and online CoPs allow teachers the chance to collaborate with others in similar contexts creating relevant opportunities for collaboration, communication, and reflection (Boschman et al., 2014; Kafyulilo et al., 2014; Vavasseur & MacGregor, 2008). Teachers can use an online platform for informal learning for collaboration opportunities and flexible access to support and resources (Kamalodeen & Jameson-Charles, 2016; Song & Bonk, 2016). Each of these interventions has been found to benefit teachers in technology integration giving them support and resources to build their technology knowledge, skills, and confidence.

The Chapter 2 needs assessment results and the review of literature showed that the proposed intervention below could provide resources and support teachers with building their technology skills and confidence. After reviewing the research literature and considering the teachers in the Ocean School District, an online PLC was used to alleviate teachers' time and distance barriers while creating a learning environment for participants to have technology supports, technology resources, and opportunities to collaborate with peers. This researcher used a virtual PLC built through Google Sites (an online platform) to foster technology integration. The site, named the Technology Support and Innovation Site (TSIS), provided teachers with the opportunity to participate in a virtual PLC through discussion posts, collaboration with peers, formal and informal learning, resource sharing, problem solving, access to support, and spotlighting technology resources.

Chapter 4: Intervention Procedure and Program Evaluation Methodology

Teachers need resources and support, including sharing lessons, collaborating with peers, accessing experts, and building communities, to increase their technology skills and confidence (Booth & Kellogg, 2015; Duncan-Howell, 2010). A review of the research literature showed that technology integration had varied definitions. Pittman and Gaines (2015) defined technology integration as technology being used in the classroom confidently to support student learning opportunities with technology-based practices to prepare students for the 21st century (Pittman & Gaines, 2015). Hsu (2016) defined technology integration as providing students with deeper understandings of learning while providing the opportunity to apply 21st century skills. Keengwe and Onchwari (2009) defined technology integration as a way of supporting teachers' curriculum using technology. Technology integration is a complex process that requires support, resources, vision, collaboration, and communication (NCES, 2002; Topper & Lancaster, 2013). For this intervention, technology integration was defined as incorporating technology in the curriculum with a focus on the technology supporting the content being taught and preparing students with skills for the 21st century (Hsu, 2016; Keengwe & Onchwari, 2009; Pittman & Gaines, 2015). For technology integration to occur teachers need technology support and resources, collaboration with peers and experts, and opportunities to build their technology skills and confidence.

The literature reviewed in Chapter 3 identified several research-based interventions to support technology integration in the classroom, including PD, PLC, CoP, and informal learning (Booth & Kellogg, 2015; Doering et al., 2014; Kafyulilo et al., 2014). An analysis of these interventions showed the need for support and authentic, relevant, long-term, and hands-on training (Ernest, 2010; Keengwe & Onchwari, 2009; Rashid et al., 2016; Unger & Tracey, 2013).

In Chapter 2 of this dissertation, participating teachers in the needs assessment identified technology skills and confidence as areas for which they desired support and resources. Thus, the researcher focused on ways to build support and supply resources within the targeted schools, so teachers could build their technology skills and confidence.

The intervention was designed to increase technology skills and confidence of teachers at three schools in the Ocean School District by creating a virtual PLC. By implementing a virtual asynchronous PLC, the researcher created a platform for inter and intraschool collaboration and resource sharing that was authentic, relevant, and could be used long-term to foster technology integration. The researcher designed and facilitated engagement on a Google site to host the virtual PLC, titled Technology Support and Innovation Site (TSIS). The procedure section of this chapter provides a detailed explanation of the virtual PLC.

Purpose of Study

The purpose of the study was to provide a platform for teachers to access and use resources and support, build technology skills, and increase confidence to promote technology integration in the classroom. Throughout the intervention, the researcher tested the hypothesis that a virtual PLC could offer resources, support, and collaboration that, in turn, would change teacher technology skills and confidence levels to support technology integration.

Process Evaluation Research Questions

The following research questions guided the evaluation of the intervention:

RQ1A: To what degree did the implemented intervention adhere to the planned intervention?

RQ1B: To what degree did participants report the virtual PLC as useful?

RQ1C: To what extent were participants engaged with the content of the virtual PLC?

Outcome Evaluation Research Questions

RQ2: To what extent did teachers report that their skills levels changed after participating in the virtual PLC?

RQ3: To what extent did teachers' technology confidence change after participating in the virtual PLC?

RQ4: In what ways did participant support for technology integration change after participation in the virtual PLC?

RQ5: How did teachers collaborate during their participation in a virtual PLC?

RQ6: To what extent did teachers' technology integration change after participating in the virtual PLC?

Research Design

A convergent parallel mixed-method design was used to understand how the virtual PLC worked with three schools in the Ocean School District. The research questions focused on how the intervention, a virtual site that teachers accessed in their school and home environments, provided support for the teachers and contributed to teachers' skills and confidence in employing technology in their classroom. The mixed-method design included collecting and analyzing multiple strands of data and triangulating that data with the purpose of strengthening the study (see Creswell & Plano Clark, 2011). The process evaluation considered the fidelity of implementation regarding adherence, quality of program delivery, and participant responsiveness in the virtual PLC and use of the TSIS. The outcome evaluation showed the following short-term outcomes found in the logic model (Appendix C): improve technology skills and confidence levels of teachers, provide support and collaboration opportunities, and improve technology integration. The quantitative measures for the study included the pre/post survey (Christensen &

Knezek, 2017; Ertmer et al., 2014), teacher-reviewed applications (apps) and sites, and Google Analytics. The qualitative measures included observations of the TSIS discussion board, open-ended survey questions included as part of the survey, reflective journal, and mid and end of the intervention focus group interviews.

Process Evaluation

Understanding the process of how the intervention was implemented and evaluating the implementation showed whether the outcomes observed were attributed to the actual activities of the intervention. The researcher gained an understanding of the planned versus the actual outcomes of the study using inputs and activities identified in the logic model (Appendix C) to study the fidelity of the implementation of the intervention (see Dusenbury, Brannigan, Falco, & Hansen, 2003; O'Donnell, 2008). The process evaluation showed aspects of fidelity of implementation that included adherence, quality of TSIS delivery, and participant responsiveness (Appendix D).

Virtual focus groups conducted mid-way and at the end of the intervention gathered qualitative feedback data from the participants' experiences and perceptions of the virtual PLC while evaluating the fidelity of implementation. The goal was to capture the voices of the participants and identify what they experienced throughout their participation in the virtual PLC. The qualitative data were used to determine the effectiveness of the virtual PLC and what elements, if any, needed to be amended. The teachers' feedback, midway through implementation of the site, acted as a measure of fidelity and guided adjustments and modifications. Google Analytics provided quantitative data on participants accessing the virtual PLC and what parts of the site were used. The analytics data included each subpage of the virtual PLC site.

Part of determining the fidelity of implementation entailed measuring adherence. Researchers use adherence to evaluate the extent to which actual implementation of the intervention aligned to the proposed plan (Dusenbury et al., 2003). The researcher observed the virtual PLC and took notes in a reflective journal to evaluate adherence. Observations of the discussion board were also used to determine if members of the virtual PLC adhered to the intervention as planned.

Another area of fidelity evaluated was the quality of program delivery. This inquiry explored whether the researcher provided an effective intervention with the ability to provide support and resources for the participants (Dusenbury et al., 2003). Virtual focus groups, the pre/post survey, and the reflective journal data were used as means to measure the quality of the virtual PLC delivery.

The last component used to evaluate fidelity of implementation focused on participant responsiveness and evaluated how the participants engaged and interacted in the intervention (Dusenbury et al., 2003). The participants used the virtual PLC to gather knowledge about resources and gather support for technology integration. Support was evident in how participants used the virtual PLC to collaborate with other colleagues by posting questions and answers, supporting one another through the discussion board, and recommending apps and sites. The frequency of participant visits was measured with Google Analytics. Another measure of participant responsiveness was the number of teachers who submitted recommended apps and sites. Measuring the intervention through the view of the participants provided data on recommendations for improvement of the virtual PLC (Dusenbury et al., 2003).

Outcome Evaluation

The logic model (Appendix C) showed the short-, medium-, and long-term outcomes intended for the study. Only the short-term outcomes were measured. The short-term outcomes included improvements in technology skills, increased confidence levels of teachers, and more opportunities for support and collaboration—all contributed to increasing technology integration (Appendix C). Each of the identified constructs is detailed in the methods section. The researcher collected and analyzed data from the pre/post survey, discussion board, reflective journal, and participant focus groups to evaluate the outcomes.

Method

Participants. The participants included 15 kindergarten through eighth-grade teachers at two public schools in the Ocean School District. School A housed kindergarten through eighth-grade students, and the researcher was an educator at this school. School B had fifth- through eighth-grade students. The third- through eighth-grade teachers at each of the schools were in their fifth year of the Ocean School District's 1:1 Chromebook initiative. In the 2019 to 2020 school year, second-grade teachers were added to the 1:1 Chromebook initiative. Due to the Coronavirus (COVID-19) pandemic, kindergarten and first grade were added to the 1:1 Chromebook initiative in March 2020 to allow for virtual learning. All the teachers and students had a district Google account and access to Google Suite.

There was a possibility of recruiting 117 teachers, the researcher would have liked for at least 30 teachers to participate in the study so that quantitative analysis could have included more rigorous statistical procedures (see O'Leary, 2014). Considering the research by O'Leary (2014) on sample sizes; the teacher population ($N = 117$) of Schools A, B, and C; and the number of participants in the needs assessment ($N = 61$), the researcher projected that at least 30 teachers

would participate, thus accounting for 25% of the population. Because participation was a voluntary time commitment on the part of the teachers, the researcher expected that participation might be lower than 50% of the teacher population at the three schools. The reason for a 25% recruitment was based on the PLC studies examined in the intervention literature review, which had a range of five to 32 participants taking part in a PLC (Booth & Kellogg, 2015; Duncan-Howell, 2010; McConnell et al., 2013).

The researcher recruited 15 out of a potential of 92 teachers from two schools in the Ocean School District. Of the teachers recruited, 14 were from School A, and one was from School B. A further breakdown of participants is detailed in Table 8. The proposed intervention included a third school to recruit a larger sample size. However, the COVID-19 pandemic going on during the study placed unforeseen additional work on teachers to deal with school district COVID-19 policies. Chapter 5 contains a further explanation of such limitations in the study.

Table 8

Participants' Demographics

Participant	Grade Level	School
Amber	8th Grade English and English 1	A
Brittanie	8th Grade English and English 1	A
Andrew	Social Studies	A
Brett	8th Grade Math and Algebra	A
Christy	7th Grade Science	A
Dee	7th Grade Science and Math	A
Elizabeth	6th Grade Math and Gifted English	A
Felicity	5th Grade	A
Gigi	5th Grade	A
Hannah	4th Grade	A
Isabella	3rd Grade	A
Jennifer	1st Grade	A
Kristian	Kindergarten	A
Linda	6th – 8th Grade Gateway to Technology	B
Megan	6th – 8th grade Guidance Counselor	A

Note. Participants' names have been changed to pseudonyms.

Measures/instrumentation. The following section explains the measures used to gather data about the constructs and answer the research questions identified in the summary matrix (Appendix D). The data sources included the pre/post survey, Google Analytics, the discussion board, teacher reviewed apps and sites, focus groups, and a reflective journal.

The pre/post survey. The pre/post survey (Appendix E) was a combination of two reliable and valid measures. The constructs measured by the items in the survey included technology integration, support, confidence, and skills (Appendix D). The survey consisted of two parts for a total of 65 questions and took approximately 30 minutes to complete.

The pre/post survey Part I, titled Technology Proficiency Self-Assessment for 21st Century Learning (TPSA C21; Christensen & Knezek, 2017) measured teacher technology confidence, technology skills, and technology integration. The TPSA C21 consists of 34-items using a 5-point Likert scale, ranging from *strongly disagree* to *strongly agree*. Participants indicated how confident they were in using technology tools, integrating technology into their curriculum, and using different applications (Christensen & Knezek, 2017). The authors reported that the TPSA C21 was reliable and valid with a Cronbach's alpha ranging from 0.76 to 0.93. The responses to this section of the survey were designed to address RQ6 technology integration, RQ2 teacher technology skills, and RQ3 teacher technology confidence (Appendix D).

Part II of the pre/post sruvey was the Exemplary Technology Integration Survey (ETIS), which measured factors believed to influence technology integration success, including computer proficiency, support, PD experiences, resources, technology use, and technology experiences (Ertmer et al., 2014). The ETIS is made up of 20 five-point Likert scale questions, six open-ended questions, two follow-up questions, two multiple-choice questions, and one checklist for a total of 31 items. Ertmer et al. (2014) found moderate reliability with a Cronbach's alpha of 0.76,

and face validity was measured through expert reviews that determined the ETIS was reliable and valid (Ertmer et al., 2014). The responses to the ETIS provided data that the researcher used to analyze RQ6 technology integration, RQ4 technology support, RQ2 teacher technology skills, and RQ3 teacher technology confidence (Appendix D).

Focus groups. The goal of the focus group interviews was to gather data on the ways the site was fostering technology support, identify evidence that teachers were building their technology confidence and skills, and to learn how teachers were integrating technology. The semi-structured, virtual focus group interviews occurred midway through (December 2020) and at the end of the intervention (March 2021). The researcher received additional data that might not have been evident from the survey, discussion board, or through Google Analytics about how teachers integrated technology in their lessons. The focus group interview questions were centered on the research questions, constructs identified in the research, and data collected from the pre/post survey, Google Analytics, and discussion board (Appendix F). Since teacher participants were from two schools, the focus group interviews occurred through an easy access virtual meet-up (Zoom) to account for different school locations and times. The researcher to record the meetings.

Discussion board. In the virtual PLC, the discussion board created an avenue for the PLC participants to collaborate with the researcher. Creating opportunities for collaboration provides teachers with sharing, reflection, feedback, and discussion opportunities with their colleagues (Richey et al., 2011). Collaboration can support the development of teacher technology skills through sharing experiences, trying recommended technology applications, and reflecting on the use of these applications within the classroom (Kafyulilo et al., 2014). The posts on the discussion board determined the support and collaboration occurring in the virtual PLC, helping

to measure RQ4 support and RQ5 collaboration. The researcher monitored the discussion board, posed questions to engage and support participants, and provided resources.

Google Analytics. Google Analytics was used to provide continuous, automatically generated quantitative data on site visitors and page views, allowing the researcher to extract and analyze the data (Kamalodeen & Jameson-Charles, 2016). The trends and cycles created by the quantitative data were used in the process evaluation to determine what participants were accessing on the virtual PLC and how often everyone accessed each section on the site. Through Google Analytics, data about participant access of the virtual PLC was collected and then analyzed and reported. The data provided evidence of the portions of the TSIS being used related to RQ1C participant responsiveness. As recommended by Farney and McHale (2013), the researcher customized reports by selecting the dimensions and metrics to measure, including top viewed pages, parts of the site searched, the number of times viewed, and time spent on the site. The Google Analytics data also assisted the development of questions for the focus group to understand why teachers were using specific parts of the TSIS over other areas of the site.

Teacher reviewed apps and sites. As part of the virtual PLC, participants had the opportunity to review apps and sites they were using in the classroom. Using a Google form, participants submitted the app's or site's name, description, use, and link or URL. Through the opportunity to submit their recommendations of apps and sites, participants could write a review of the resource and reflect on how these apps and sites could be used in their classrooms. The data collected from this measure helped determine RQ1C participant responsiveness, RQ4 technology support, and RQ5 collaboration.

Reflective journal. Throughout the study, the researcher used a reflective journal to record observations and thoughts about the interactions in the discussion board, focus group

interviews, in-person conversations, informal e-mails, and phone conversations. The reflective journal gave a visible trail of interactions during the virtual PLC, helping determine RQ1A adherence.

Procedures

The following section describes participant recruitment, the intervention, timeline, data collection, and data analysis.

Intervention. The intervention was a virtual PLC using a Google Sites platform, titled TSIS, conducted October 2020 through mid-March 2021. Participant recruitment occurred in late September 2020, with the researcher attending a virtual (Zoom) teacher meeting for each school. During the teacher meeting, the researcher shared details of the study, provided an overview of TSIS, discussed how participants could participate in the study, outlined the data collection plans, and took teacher questions. After the presentation, an email was sent out to all the teachers at each school with the digital informed consent to sign and return to the researcher. The researcher's email and phone number were provided so that teachers could reach out with questions or request clarifications about the research study.

An email was sent to those unable to attend the recruitment presentation to increase the likelihood of teacher participation. The email included a flyer (Appendix G) on the virtual PLC and an explanation of the research study. A digital consent form was also included in the email. If teachers were interested, they could sign the digital consent form and email it back. A follow-up email was sent a few days later to all teachers at each school to ensure those who wanted to participate remembered to send back their signed consent form.

When the researcher received informed consent, the consenting participant received an email with a link to the pre-survey and a reminder to complete the survey within the week. A

reminder email was sent mid-way through the week to participants who had not completed the survey. Participants who completed the pre-survey and informed consent were emailed the date, time, and Zoom link for the instructional support session, which took place in early October 2020. The virtual, synchronous instructional support session provided information on how to use and navigate through the TSIS. A virtual platform (Zoom) for the support session was used, so all participants from the two schools could attend. For participants who could not attend on the day of the synchronous session, a Screencastify recording was sent to them. After the support session, the researcher sent an email to all participants with the link to the virtual PLC.

Technology support and innovation site. TSIS (Figure 3), the virtual PLC platform, gave participants access to technology resources, support from their colleagues, and the researcher. The participants had to log into their school district Google account to use the site. Only the teachers who signed the informed consent and completed the pre-survey had access to the TSIS for this intervention.

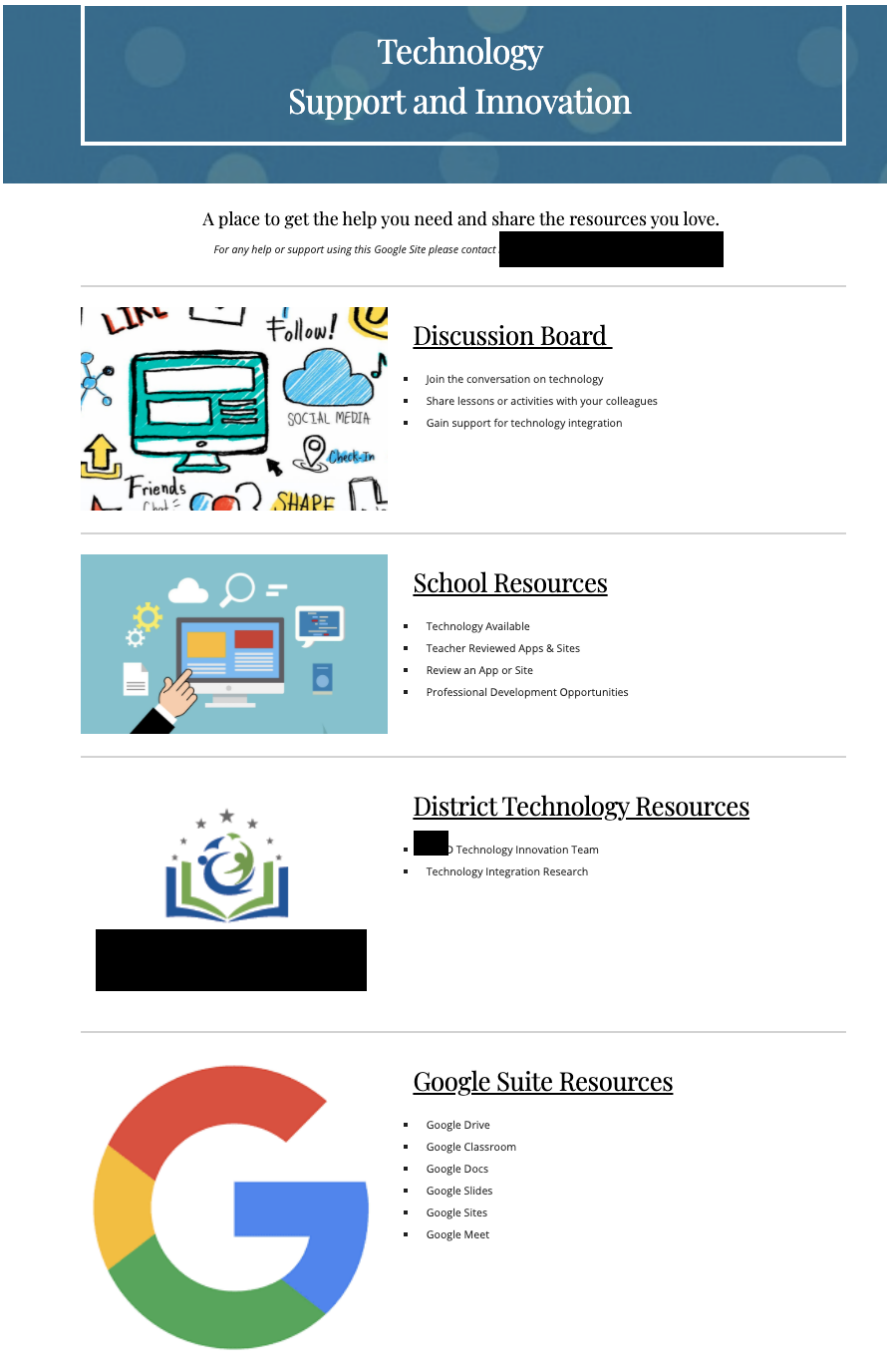

Figure 3. Technology support and innovation site.

The site has four sections with resources available from the Ocean School District and additional resources created by the researcher. The researcher created the discussion board and school resources sections while the other resources are publicly available or created by Ocean

School District. All the sections provided participants with access to technical support and resources to build teacher technology skills and technology confidence levels. Screenshots of each section, as well as the URL, are provided in Appendix H.

Discussion board. This section provided participants the opportunity to collaborate and interact with their colleagues. The discussion board was used to pose technology questions, share ideas, and gather support from colleagues on integrating technology into their instructional practices. Throughout the intervention, the researcher checked the board weekly and posted questions to engage participation and prompt discussions on technology integration, lesson sharing, resource sharing, and peer support. Participants received a weekly email to highlight what was being discussed and encourage more participation on the discussion board and highlight available new resources to try.

School resources. The school resource section created a central location for participants to access technology resources. Having a central location may save time for participants and provide them with resources reviewed by their peers, the district innovation coach, and the researcher. The school resources section has four distinct subsections for ease of use; teacher reviewed apps and sites, review an app or site, the technology available, and PD.

Figure 4. School resources.

The School Resources section contained a Review an App or Site subsection to foster collaboration and share resources among participants; teachers could submit, on a Google form (Appendix I), an app or site they had successfully used in their classrooms. The apps and sites recommended by participating teachers were added to the Reviewed Apps or Sites sub-section. In the Professional Development sub-section, participating teachers could access a regularly updated list of technology learning opportunities they may want to attend. The Technology Available subsection contained technology hardware and software currently available at the schools and resources to use the technology. Participants were able to use the school resources section to gather knowledge to support their technology integration and more effectively use the technology they currently have in their classrooms.

District technology resources. The district technology resource page was divided into the Ocean School District technology innovation team, technology integration research, and Ocean School District blended learning. The technology innovation team subsection provided participants a direct link to accessing the district innovation coach website. The researcher curated the research subsection for easier access for participants on up-to-date technology integration research. This subsection contained research and professional articles that provided participants with up-to-date research on models, frameworks, and resources connected to technology integration in their classrooms. The blended learning subsection gave participants a direct link to the Ocean School District blended learning resources created by the district during the 2020/2021 school year.

Figure 5. District technology resources.

Google Suite resources. The Google Suite section provided how-to videos on using different Google applications, including Google Classroom, Google Docs, Google Slides,

Google Drive, and Google Meet (Appendix H). The advantage of putting the Google resources in a central location was less time spent on searching for resources in multiple locations throughout the internet. In addition, the Google Suite resources had links to additional resources, such as Six Tips for Getting Started with Google Classroom, G Suite Learning Center, and Student-Teacher Chrome Extensions, supporting participants as they built their skills and confidence in using components of Google in the classroom.

Data collection. The process and outcome evaluation data were collected concurrently during the research study and are described below. A data collection timeline outlined the intervention (see Table 9).

Table 9

Data Collection Timeline

Measure	Quant	Qual	Timeframe	Description
Pre-survey	X	X	End of September beginning of October 2020	Teacher participants received a link to the pre-survey and were given a week to complete.
Mid focus group interviews		X	December 2020	Researcher conducted virtual meetings with teacher participants who volunteered to take part.
Post-survey	X	X	March 2021	Teacher participants received a link to the post-survey and were given a week to complete.
End focus group interviews		X	March 2021	Researcher conducted virtual meetings with teacher participants who volunteered to take part.
Google Analytics	X		Bi-weekly checks from October to March	Once the site was live, each week the researcher gathered quantitative data on teacher access of the virtual PLC.
Discussion board		X	Weekly checks of board as well as a review of board at mid-point and end of intervention	Once the site was live, the researcher engaged in the board weekly and promoted discussion as needed. Data were collected mid-point and end of intervention.
Reviewed apps and sites Google form	X		Every Friday during the intervention	Once the site was live, each week the researcher gathered the app and site recommendations. Recommendations were placed in the resource section of the TSIS.
Reflective journal		X	Throughout the intervention	Researcher regularly reflected on interactions with participants and the intervention

Pre/post survey. The survey was administered pre- and post-intervention to measure a change in the participants' reported technology skills, technology confidence, and technology integration (Appendix E). The pre-survey was used as a baseline at the start of the intervention and to provide suggestions for other resources that might need to be added to the virtual PLC. Once the survey was completed, the data was automatically uploaded to the researcher's Google Drive in a Google spreadsheet. Each participant was assigned a pseudo name on the Google Sheet for anonymity. Data on the survey collected quantitative and qualitative data to address how teachers' technology skills, technology confidence levels, technology support, and technology integration were affected by taking part in the virtual PLC (Appendix D).

Discussion board. Throughout the intervention, the researcher monitored and engaged in the discussion board to collect qualitative data from the participants' posts. Posts made on the discussion board were stored on the discussion board section of the TSIS, and the researcher received a notice when a participant posted on the site. In the middle and at the end of the intervention, the discussion board was reviewed to gather qualitative data to identify constructs measured in RQ1A, RQ1B, RQ4, and RQ5. The researcher conducted weekly checks and took notes in a reflective journal on what was being discussed, how or if participants were interacting, the types of questions and issues being posted, and the different threads created. Documentation of the discussion posts provided additional data on participant experiences in the intervention. Monitoring and examining the discussion posts occurred throughout the intervention to determine the extent to which participants collaborated and what type of support was requested by the participants.

Reflective journal. A digital reflective journal was used during the implementation of the intervention and throughout the study. Notes in the journal produced anecdotal data and included

observations from the discussion board, thoughts about the trends emerging from Google Analytics, recommended apps and sites, focus group interview reflections, and annotations of any anomalies about the virtual PLC. The journal was periodically reviewed to identify patterns, guide the codes, and find themes emerging from the research. The data collected in the digital reflective journal was kept in a secure Google Drive.

Google Analytics. Weekly reviews of Google Analytics occurred to track when participants were most active on the site, which pages on the site were frequented, and week-to-week participant use. Through Google Analytics, the researcher generated reports to collect quantitative data. All reports were stored in the secure Google Drive for later analysis.

Teacher reviewed app and sites. When the virtual PLC went live in October 2020, teachers began adding their recommendations of apps and sites they were using in their classrooms. All of the teacher recommendations were made through a Google form that generated a Google sheet in the researcher's Google Drive. The researcher reviewed the app or site and then placed the recommendations in the sub-section: teacher reviewed apps and sites. Quantitative data were collected to address the constructs of participant responsiveness, technology support, and collaboration. This process was done by keeping track of how many participants made recommendations and how many recommendations were made throughout the intervention.

Focus group interviews. Focus groups consisted of three to four participants, with two focus groups taking place midway through the intervention including three participants in December Focus Group A and four participants in December Focus Group B. Two focus groups were conducted at the end of the intervention with the March Focus Group A having four participants and the March Focus Group B having three participants. Before the mid-focus

group, an email was sent out to everyone participating in the intervention inviting them to participate in a focus group (Appendix J). Data collection occurred mid-way through the intervention, with focus group interviews taking place in December 2020. Focus group interview data were also collected after the intervention had been completed in March 2021. The focus group interviews were recorded with Zoom and used to collect qualitative data. The researcher uploaded the recordings and transcriptions to Google Drive, where they were stored. The transcriptions were reviewed to identify patterns and codes, including RQ2 teacher technology skills, RQ3 teacher technology confidence, RQ4 technology support, RQ5 collaboration, and RQ6 technology integration.

Data analysis. Through a convergent parallel mixed method design, the qualitative and quantitative data were analyzed independently and then combined for a more thorough review (Creswell & Plano Clark, 2011). The researcher triangulated the data from the research study to analyze the intervention in multiple ways, thus strengthening the study (O'Leary, 2014). Having multiple data sources was one form of triangulation that allowed the practitioner to understand the intervention fully (Krefting, 1991). Triangulation of the survey, discussion board, and focus groups occurred by collecting and analyzing data qualitatively and quantitatively to strengthen validity in the study. Once the qualitative and quantitative data analyses had occurred, the data was then triangulated by comparing the data for common themes, outliers, and differences (Krefting, 1991). By comparing the analyzed data, the researcher could understand what part or multiple parts of the intervention supported teachers in building their technology integration skills and confidence.

Qualitative. The qualitative data analysis was conducted using a thematic approach to identify patterns and themes. Data collected from the focus groups, discussion board, reflective

journal, and the open-response items from the pre/post survey Part II were reviewed for patterns within the data using Braun and Clarke's (2006) six phases of thematic analysis: familiarization with the data, coding, searching for themes, reviewing themes, defining and naming themes, and writing up the findings.

The researcher used the constructs identified in the literature and written in the research questions to guide the deductive coding. The first step in the thematic analysis was to review data recorded in the discussion board posts, the transcripts from the focus group interviews, the open-ended survey questions, and notes from the reflective journal. Reading and rereading the data helped the researcher identify initial patterns (Braun & Clarke, 2006). The coded qualitative data was labeled and placed into groups to identify themes, which were then placed into the codebook found in Appendix K (Braun & Clarke, 2006).

Once the themes were created, they were checked by comparing the codes and data sets to determine how they fit together (Braun & Clarke, 2006). Using the intervention literature review, each theme was defined (Appendix K). The researcher then finalized the themes and told a story through the data (Braun & Clarke, 2006). Part of reporting the results included connecting the existing literature to the data. By coding and identifying themes in the data, the researcher determined if the intervention affected teachers' technology skill and confidence levels, technology support, and helped support technology integration.

Quantitative. Using descriptive statistics, the researcher analyzed the data, including calculating the mean and standard deviation. Analyses were conducted to evaluate RQ2 technology skills, RQ3 technology confidence, RQ4 technology support, participant responsiveness, and RQ6 technology integration (O'Leary, 2014). Using the same survey for the pre- and post-intervention helped create a baseline for what the participants knew and used prior

to the intervention, which then were compared with their technological knowledge and usage at the end of the intervention (Shadish, Cook, & Campbell, 2002). The data collected through Google Analytics was analyzed using descriptive statistics to measure how often participants accessed the virtual PLC site and what areas were accessed. The apps and sites recommendation were analyzed using descriptive statistics to measure participant responsiveness of how many participants made recommendations and how many recommendations were made (see Appendix for Table D1: Summary Matrix).

Chapter 5: Findings and Discussion

The following chapter presents the findings of the convergent parallel mixed-method research study. The purpose of the study was to provide teachers at two schools with resources, support, and collaboration through a virtual, technology integration-focused PLC while building technology skills and confidence. Chapter 4 showed the process and design of the intervention. The subsequent sections provide a discussion of the findings from the evaluation of the intervention and a review of important connections and distinctions between the results and the chapter 3 literature. Finally, the chapter concludes with recommendations and limitations of the virtual PLC intervention.

Process of Implementation

The researcher implemented a virtual PLC through a Google site created by the researcher to provide teachers at Ocean School District with a platform to access and use resources, collaborate with peers, build technology skills, and increase confidence with technology integration. The virtual PLC was implemented from October 2020 through March 2021. The virtual PLC was intended to occur with three schools in Ocean School District; however, during the recruitment process, teachers from only two of the three recruitment schools volunteered to participate. Intervention implementation occurred during the COVID-19 pandemic; subsequently, teachers had more responsibilities as they were required to simultaneously teach students face-to-face and virtually, with what the school district leaders called blended learning. Due to the blended learning model, there were more time constraints on the teachers than originally expected. Consequently, only 15 participants from two of the three selected schools at Ocean School District participated.

The intervention was implemented as described in Chapter 4. Participants had access to the virtual PLC from October 2020 through March 2021. Throughout the intervention, the researcher encouraged participation through emails to the participants that included the new questions posted on the discussion board, new apps and sites recommended, and a link to the Technology Support and Innovation Site (TSIS). By including a link to the TSIS in the emails throughout the study, the researcher ensured that the participants had access to the site, just in case they did not bookmark the link. The discussion board was monitored weekly to answer and post questions. The teacher-recommended apps, sites, and Google form were also checked weekly to update the recommended resources on the TSIS. Most participants were from the same school as the researcher, which allowed them to reach out to the researcher through the school intercom phone as well as the virtual PLC. Several participants were also situated near the researcher's classroom, allowing for face-to-face interactions.

Employing a convergent parallel mixed method design, the researcher analyzed the qualitative and quantitative data from the study. The research questions, including process and outcome evaluations, guided the analyses:

Process evaluation research questions.

The following research questions guided the evaluation of the intervention:

RQ1A: To what degree did the implemented intervention adhere to the planned intervention?

RQ1B: To what degree did participants report the virtual PLC as useful?

RQ1C: To what extent were participants engaged with the content of the virtual PLC?

Outcome evaluation research questions.

RQ2: To what extent did teachers report that their skills levels changed after participating in the virtual PLC?

RQ3: To what extent did teachers' technology confidence change after participating in the virtual PLC?

RQ4: In what ways did participant support for technology integration change after participation in the virtual PLC?

RQ5: How did teachers collaborate during their participation in a virtual PLC?

RQ6: To what extent did teachers' technology integration change after participating in the virtual PLC?

Findings

The researcher examined how teachers of a virtual PLC could offer resources, support, and collaboration to build technology skills and increase technology confidence. The goal was to support technology integration. Once the data had been analyzed the findings were organized by research questions.

Evaluation of the Process

The process evaluation research questions were developed to study the fidelity of implementation of the intervention, which included adherence, quality of TSIS delivery, and participant responsiveness. By studying the fidelity of the implementation of the intervention, the researcher was able to gain an understanding of the planned versus the actual implemented virtual PLC (Dusenbury et al., 2003; O'Donnell, 2008). The process evaluation enabled observing the fidelity of implementation in terms of adherence, how close the planned intervention was to the implemented virtual PLC; quality of program delivery, the engagement

and usage of the virtual PLC; and responsiveness, how engaged participants were in the virtual PLC (Dusenbury et al., 2003; O'Donnell, 2008).

Adherence. RQ1A, to what degree did the intervention as implemented adhere to the intervention as planned, was evaluated through observing the virtual PLC documented in the reflective journal and the discussion board. Adherence was measured to determine the fidelity of implementing the actual intervention to the proposed intervention (see Dusenbury et al., 2003). The virtual PLC was implemented as intended by following the research design outlined in Chapter 4. The TSIS went live for participants in October 2020, and the researcher sent reminder e-mails throughout the intervention. Throughout the course of the virtual PLC, participants took part in the discussion board through collaborating with and supporting each other. Participants also reached out to the researcher for support and collaboration by face-to-face interactions, phone calls, and e-mails. These conversations were recorded in the researcher's reflective journal and concerned support, hardware, software, technology integration ideas, and technology use. The teacher-recommended apps and sites were also implemented as intended, with participants making recommendations throughout the study. The research study was implemented as intended, without any variations to the virtual PLC.

Quality of technology support and innovation site delivery. RQ1B, to what degree did participants report the virtual PLC as useful, showed the fidelity of the quality of the program delivery. Qualitative analysis occurred using Braun and Clarke's (2006) six phases of thematic analysis to identify patterns and themes from focus group conversations and researcher's reflective journal. The researcher read over the data to become familiar with the data while coding the data, searching for themes, and defining and naming those themes. The codes were developed deductively through the literature review and constructs. The themes were then

created from the codes. Once the themes were identified, they were defined using the literature review.

Through the qualitative analysis, collaboration, resources, and support emerged as areas of the virtual PLC that participants indicated as useful (Appendix K). In the March Focus Group A, Elizabeth explained, “Just in general, sharing strategies and websites, I’ve had to go about it really different this year. So, I feel like the virtual PLC has definitely benefited me, especially this year.” Dee stated, “Sharing online, it’s really nice so we can refer back to it but it’s also nice to possibly meet and show each other as well” (March Focus Group B). The focus group participants indicated that being able to refer to what was shared online through the virtual PLC was useful for sharing participants’ resources. Andrew made the following clear: “I look at other people’s ideas, the best way for me to get stuff is to see what other people are using and what their experiences are with it” (December Focus Group B). Analysis of focus group data showed the virtual PLC as useful to participants to reference back to resources.

The discussion board was the most useful part of the virtual PLC, as identified by the focus group interviews, having the most visits as indicated through Google Analytics. In December Focus Group B, Christy shared, “I was just goanna [going to] add that the discussion board, it was a great sounding board to get ideas.” The discussion board provided a way for participants to ask questions and share resources. The researcher encouraged participants by sending email reminders to review and interact on the virtual PLC. Brittanie conveyed, “Every time I got an email from you that would be my, oh yeah, reminder that I wanted to go check the virtual PLC. Then I would spend some time reading through the discussion board” (December Focus Group A). Elizabeth, Linda, and Dee asked, in the focus group interviews, if the discussion board could have a way for participants to record videos. They explained that having

this option would give another way for participants to see how to integrate the technology and how their colleagues used the resources. The participants also indicated that knowing how to set up discussion board notifications would have been beneficial, as discussed further in the limitations and recommendations sections.

The recommended apps and sites section of the TSIS had mixed reviews but was determined not as useful as the researcher intended. Taking into account the circumstances that the participants were dealing with throughout the school year it is noteworthy to recognize that participants did make recommendations and did visit the recommendations subsection of the TSIS. Only five out the 15 participants made recommendations through the Google form. Reviewing the Google Analytics data, the researcher found that the recommended apps and sites section of the virtual PLC was visited 13 times by nine participants throughout the 5-month study. Amber described the following in the March Focus Group A:

> I thought that the websites or the place where we were going to put all the apps and things was going to be the most valuable thing. I, for some reason, haven't really used that much. So like, I don't know why that is. I was just thinking about it like, I don't know why I haven't really visited it that much, but I do use the discussion board more and I was just more aware of the discussion board.

Amber made three recommendations on the apps and sites' Google form. Linda made one app and site recommendation during December Focus Group A. Linda would first go back to the list of recommended apps and sites when looking for a resource. The reason was that the apps and sites had been tried out already, and Linda knew none would be blocked by the school district filters. The participants indicated in the focus group interviews that having some type of reminder or notification might have helped with gathering more recommendations. Similar to the

Duncan-Howell (2010) and McConnell et al. (2013) studies, the virtual PLC in this research was found to be useful for time and relevance. Analysis of the focus groups, discussion board, and Google Analytics data indicated that the virtual PLC was supportive and useful.

Participant responsiveness. RQ1C, to what extent were participants engaged with the content of the virtual PLC, showed fidelity of implementation by focusing on participant responsiveness. The researcher reviewed the discussion board, focus group interviews, teacher recommended apps and sites, and Google Analytics to measure participant responsiveness with engagement and interactions through the virtual PLC (see Dusenbury et al., 2003). The highest level of engagement came from the discussion board, as shown through data analysis of the discussion board. The findings indicated the following: a participant engagement of 60%, with nine of 15 participants engaging with the discussion board. One of the nine active participants was the teacher from the second school in the study. Out of 15 participants, three interacted with the researcher only through face-to-face and over the phone interactions. These three participants did not interact on the virtual PLC, but the Google Analytics data (Appendix L) showed that they visited the TSIS and discussion board. The three other participants did not engage with the discussion board, researcher, or recommended apps and sites. However, Google Analytics data (Appendix L) indicated that these three participants did visit sections of the TSIS. Engagement on the discussion board included participants collaborating with one another, seeking support for blended learning, lesson and activity sharing, and gathering resources. In the focus group interviews, participants recommended adding opportunities for meeting virtually or in person to share resources with each other. Elizabeth stated, “We had the discussion board, but it would have been cool to have face-to-face or virtual meetings, I don't know, then you could actually present and do a share out version” (March Focus Group B). Ideas discussed in the focus group

included how to use different apps and sites that participants came across or used to support technology integration.

Data were collected through Google Analytics. The findings showed 160 visits to the virtual PLC occurred over the course of the 5-month intervention, with 68 to the discussion board. Table 10 shows a more detailed breakdown of the visits.

Table 10

Participants Visiting Virtual Professional Learning Communities Through Google Analytics

Section and subsections of the technology support and innovation site (TSIS)	Number of visits	Number of participants
Discussion board	68	15
TSIS home page*	47	15
School resources	21	9
Teacher reviewed apps and sites	13	9
Technology available	4	4
Google suites	3	2
Professional development	2	2
District technology	1	1
Technology integration research	1	1

*TSIS home page refers to the 47 visits to the TSIS home page because participants could use the home page to access other parts of the virtual PLC, as well as a description of the virtual PLC and the researcher's contact information.

The findings from Google Analytics showed that the participants barely used the technology available, Google Suites, professional development, district technology, and technology integration research sections of the TSIS throughout the intervention. Data from Google Analytics also indicated that during February 4th to 11th, no visits occurred to the TSIS. On February 25th to March 4th, only three visits occurred—all to the discussion board. The researcher compared the Google Analytic data to the researcher notes in the reflective journal. The findings showed that during this time, the participants dealt with COVID-19 outbreaks within several of their classrooms.

The teacher-reviewed apps and sites were only visited 13 times during the intervention, aligning with the findings and data found in RQ1B, where five participants made nine recommendations. Through the focus groups, the participants indicated that they appreciated having the apps and sites' recommendations but would like some type of notification showing when new ones were added as they would often forget about checking this page in the TSIS. The participants appreciated that there was one central location for the links to the apps and sites. For example, Dee said, "The reviewed apps and sites are a great resource to go back to, and I wish I would have added more, it's just that *immediate* time, that has been difficult" (December Focus Group A). Even with the researcher sending email reminders with spotlights on new recommendations and the link to the Google form, a lack of participation still occurred with recommended apps and sites. The findings indicated that participant engagement occurred through the discussion board section of the virtual PLC, with the other sections and subsections of the TSIS not accessed as frequently by the participants.

Evaluating the fidelity of implementation, including adherence, quality of TSIS delivery, and participant responsiveness, showed if the intervention was implemented as intended by the researcher. The observations of the virtual PLC showed that the intervention adhered to the plan intended by the researcher. The quality of TSIS delivery was found useful to the participants, with the discussion board section of the virtual PLC as the most useful. Lastly, the participants were responsive to the virtual PLC, specifically through the discussion board, but further improvement would be needed in other areas of the TSIS. In conclusion, the virtual PLC was delivered as planned and was seen as useful to the participants.

Evaluation of the Outcomes

The evaluation of outcome research questions were built around the short-term outcomes identified in the logic model (Appendix C). From the short-term outcomes the research questions were centered around technology skills, increased confidence, opportunities for support and collaboration, and increased technology integration. Qualitative and quantitative date was collated and analyzed to evaluate the outcomes.

Technology integration skills. RQ2, to what extent did teachers report that their skills levels changed after participating in the virtual PLC, was answered through qualitative analysis of the focus group interviews and quantitative analysis of the pre/post survey. The researcher reviewed the focus group transcripts identifying codes deductively from the constructs and literature review. Codes that were identified from the theme skills included skill growth, still growing, and hardware *vs*. software (Appendix K). The theme for RQ2 was identified as skills and defined using the literature review. In the December focus group, the participants reported being unsure that they had experienced any real changes in skill level. For example, Linda stated, "I don't know if my skill level has changed but I definitely feel that I am much more efficient in my intentional use of technology" (December Focus Group A). Amber indicated in the December and March focus group, she had seen skill growth in using hardware technology, including using web cameras and microphones. Perhaps, a reason for this change was related to the district requirement of switching to a blended learning approach and preparing the classroom for live streaming and virtual learning while teaching students face-to-face.

In the March focus group. interview participants discussed skill growth, with specific mention of hardware, blended learning, and Google Meets. Google Meets was the virtual platform that teachers were required to use with blended learning. Both Amber and Elizabeth

explained that they had grown their skills using Google Meets and breakout rooms. For example, Elizabeth stated the following:

> I feel like the skills this year that I've gained is hosting Google Meets and teaching virtually through a Google Meet …. Definitely still growing, but I've learned a lot with that specific skill and being part of the group again it helped. (March Focus Group B)

Participants also indicated that they still had room for growth, as Christy made clear in March Focus Group B: "I still have room to grow but I do run over to you [researcher] and ask for help. I have grown with having this virtual PLC and discussion board." Because Christy was near the researcher, she could get support throughout the intervention in real-time instead of waiting for help in the virtual platform. Other areas of growth that participants noted, in the December and March focus group interviews, were not necessarily related to their skills growing but being more efficient at using the technology. An example includes starting and running Google Meets with a web camera. Another area was more patience with using technology, including not getting frustrated when the technology did not work according to plan the first time. For example, in March Focus Group B, Dee discussed working with new Smartboards and building her patience as using the new technology device did not always go according to plan. Thus, she had to improvise sometimes.

The skills subsection of the pre/post survey results in Table 11 were analyzed through descriptive statistics measuring the mean and standard deviation. All the participants took the pre/post survey ($N = 15$). The participants used a 5-point Likert scale, ranging from *strongly disagree* to *strongly agree*, for integrating applications. The participants were asked to rate computer proficiency, success with technology, and failure with technology using a 5-point

Likert scale, ranging from *extremely influential* to *not influential*. The findings indicated that the participants had a slight change of skill growth from the pre-survey to post-survey.

Table 11

Descriptive Statistics Results of the Skills Subsection of the Pre/Post Survey

Category	Pre-survey		Post-survey	
	Mean	Standard deviation	Mean	Standard deviation
Integrated applications	4.2	1	4.7	0.5
Computer proficiency	2.9	0.6	3.1	0.6
Previous success with technology	4.1	0.9	4.2	0.8
Previous failure with technology	3.7	1.3	4	0.8

Comparing the pre/post survey results with the focus group results, skill growth was found to have occurred coming from the focus group findings. The participants in the focus groups expressed if they had growth and detailed that growth. Conversely, in the survey, they had specific questions and scales to answer. The finding of not much skill growth in the survey could also be due to the participants trying to answer the pre-survey with the researcher in mind and being more honest in post-survey responses.

The overall findings of the study indicated that the participants had skill growth during the virtual PLC. The focus group interviews results showed that the participants saw some changes in their skills of using technology. This change might have been supported by the virtual PLC and demands of the blended learning required by the district due to COVID-19.

Confidence in technology integration. RQ3, to what extend did teachers' technology confidence change after participating in the virtual PLC, showed teachers' confidence in technology integration through the TSIS and focus group interviews. The focus group interviews were transcribed and analyzed for codes to identify participants confidence in technology integration. Using a codebook some of the codes identified were adapting, exposure, and

confidence grown. From those codes, the theme was identified as confidence and defined through the literature (Appendix K).

In the December focus group, the participants suggested that both the virtual PLC and challenges of the school year from COVID-19 and blended learning made them more confident with technology. For example, Brett described the following:

> The virtual PLC in combination with all the extra challenges of this year have made me feel more confident. I think things [new technology apps, resources, and blended learning] like this just take time and getting used to the one new thing and being able to use it well. I think is better than trying to do a whole bunch of different little things. (December Focus Group B)

The participants in the December focus groups found the discussion board and the list of recommended apps and sites helpful for building their confidence. Christy, Dee, Brett, Andrew, and Brittanie stated that their confidence grew since starting the virtual PLC. Dee also informed the researcher that she took a master's class based around technology that might have contributed to her growth in confidence.

The participants also specified in the March focus group interviews, their confidence in technology integration had grown, but they still had room to continue building their confidence. Elizabeth stated, in the March Focus Group B, the following about her confidence: "I would say it's grown for me. It was completely pushed even further this year, and the virtual PLC, definitely helped me." Confidence growth included trying new things, adapting, being more aware, and feeling less frightened to try. For example, Andrew conveyed, "I think what's worked for me is I'm less frightened to try some new technology and less frightened to see it fail" (March Focus Group A). The participants explained that confidence growth was influenced by

participation in the discussion board, collaboration, and communication through the virtual PLC. Amber suggested that the virtual PLC

> broadened my ideas or maybe kind of exposed me to some different things, but I have always had an interest in technology. So, I wouldn't say it increased my confidence in it, but it definitely has helped me be aware of it more. (March Focus Group B)

The participants also identified that the unusual circumstance of the school year, regarding COVID-19, influenced their confidence. Overall, the December and March focus group interview findings indicated that the participants increased their confidence in technology integration.

The pre/post survey was analyzed quantitatively through descriptive statistics, including the mean and standard deviation (see Table 12). These descriptive statistics are presented in Table 12 below. Due to the low participation in the research study, the researcher was unable to conduct any significance tests.

Table 12

Descriptive Statistics Results of the Confidence Subsection of the Pre/Post Survey

Category	Pre-survey		Post-survey	
	Mean	Standard deviation	Mean	Standard deviation
Confidence with emerging tools	4.5	0.8	4.9	0.4
Confidence with WWW	4.5	0.9	4.9	0.4
Confidence with e-mail	4.6	0.8	4.8	0.3
Inner drive-willingness to spend extra or personal time on developing lessons that incorporate technology	3.9	1.2	4.8	0.4
Personal beliefs/attitudes-beliefs that technology is important to student learning	4.5	0.7	4.4	0.8
Confidence: How comfortable you are with technology use	4.2	0.9	4.2	0.7
Time-opportunities to explore or "play" with new technologies to incorporate into classroom	4.4	1.1	4.3	0.9

The focus group interview participants reported confidence growth concerning participating in the virtual PLC. However, the circumstance of the school year, including

teaching during a pandemic and using the school district blended learning approach, might have influenced the participants' confidence growth.

Technology integration support. RQ4, in what ways did participant support for technology integration change after participation in a virtual PLC, showed how the virtual PLC supported technology integration. Data analysis was conducted qualitatively through the discussion board and Part II of the pre/post sruvey. Through thematic analysis, codes were created deductively including resources, tools, feedback, connecting with peers, and help (Appendix K). Support was identified as the theme and defined as opportunities for teachers to gain access to technology integration resources (Ertmer et al., 2012; Inan & Lowther, 2010a).

The participants used the discussion board for support with creating or modifying lessons. For example, Christy posted the following on the discussion board: "I really want to use Ozobots again this year to review the route of the digestive, excretory and circulatory systems. Any ideas of using Ozobots with our blended students?" Other topics of lesson support involved ways to peer edit with blended learning, turning paper documents into a digital format for students to work on, and how to use different apps and technology tools. Another area of support found in the discussion board entailed asking for resources or tools that could support blended learning. For example, Amber posted the following on the discussion board: "I am curious how everyone is managing group work. I have tried a few things myself, but I am wondering what is working well for others."

The researcher also posted questions dealing with ways to support technology integration. The following shows an example of a question posted on the discussion board by the researcher: "Has anyone come across a technology tool they are using right now that is working great for face-to-face and virtual? Does anyone have a lesson they would like to share that went really

well with technology integration?" From that post, four participants commented with recommendations for what they used, which included Scholastic Story Works, Parlay, and Sketch Pad.

Part II of the pre/post survey had an open-ended question on support. The participants were asked about what ways their school could support them with computer use. In both the pre- and post-survey, the participants indicated that having more time to work with the technology and getting to know the technology helped. The participants also indicated more purposeful planning would help, which the participants defined as time to plan and collaborate with colleagues to determine how to integrate technology. The participants in the focus group interviews also discussed time as an influencing factor on their engagement with the virtual PLC.

Data were analyzed quantitatively through descriptive statistics of the pre/post survey and the recommended apps and sites' Google form. Table 13 shows the results for each question from the support subsection of the pre/post survey. The participants were asked to rate the elements regarding influence on a Likert scale, with 5 being *extremely influential* and 1 being *not influential*. The descriptive statistics of this subsection are displayed in Table 13 below.

Table 13

Descriptive Statistics Results of the Support Subsection of the Pre/Post Survey

Category	Pre-survey		Post-survey	
	Mean	Standard deviation	Mean	Standard deviation
Rate the following elements in terms of the influence (in-service PD, workshops, training, etc.)	3.6	0.7	3.8	0.9
Rate the following elements in terms of the influence (support from other teachers or peers)	4.4	0.7	4.2	0.8
Rate the following elements in terms of the influence (key influential people-mentors or other personal influences on your technology integration)	3.9	0.8	4.2	0.7
Rate the following elements in terms of the influence (access to technical support)	4.5	0.7	4.2	0.8

A total of nine apps and sites recommendations were collected from five of 15 participants, helping to create a list of apps and sites that could support technology integration. Even though there were only nine recommendations made over the five months of the intervention, some participants were able to find time to make these recommendations while working with a blended learning model and experiencing a pandemic. The apps and sites recommended fit into all subject areas and grade levels—kindergarten through eighth grade. Some of the apps and sites recommended included EdPuzzle, Vector, Parlay Ideas, and personalized learning resources. Reviewing the qualitative, the findings of RQ4 indicated that participant support for technology integration occurred through the discussion board part of the virtual PLC, with some support occurring through the recommended apps and sites.

Collaboration. RQ5, how did teachers collaborate during their participation in a virtual PLC, showed participant collaboration through qualitative thematic analysis of the discussion board and focus group interviews. Through deductive coding, the researcher identified conversations, discussion board, meeting, and blended learning as some of the codes for the theme collaboration (Appendix K). The participants collaborated through the discussion board, face-to-face interactions, phone calls, and emails. The main collaboration ideas dealt with the following topics: ways to do group work while teaching using blended learning, seeking support on lessons and activities being planned, and sharing and searching for resources.

One example was when Amber posted the following on the discussion board: “Hi everyone! I am curious how everyone is managing group work. I have tried a few things myself, but I am wondering what is working well for others.” In another discussion board post, Elizabeth posted about a face-to-face interaction with Amber concerning how to make peer editing work with blending learning. Elizabeth stated, “Thanks to Amber for helping me think this one

through, while having to re-think old lessons and ways of doing things. We were starting peer editing and teacher conferencing for our latest writing assignment."

The researcher posted questions based on the data collected from the pre-survey to create collaboration opportunities on the discussion board. One question posted on the discussion board by the researcher was the following: "I would love if you could share one lesson, activity, app, site, or any other form of technology integration you have done in your classroom this year. Please feel free to share however works best for you." Three participants responded with examples and questions for each other.

In the focus group, the participants identified the discussion board, face-to-face interactions, and phone conversations as ways they collaborated. Amber implied, "In terms of collaboration, it's definitely the discussion board that I thought was very helpful" (March Focus Group A). On the other hand, Andrew found it easier to collaborate by looking over the discussion board and recommended apps and sites than by going to the person who shared the resource to ask questions and get support on the resource. Another form of collaboration entailed calling the researcher for help with technology integration. Andrew explained the following:

> I always, you know dial 3110 [researcher's phone extension], always calling with questions. It's the hotline. So, if I struggle with something, I mean it's nice having, you know, your knowledge I can go there and say hey I'm struggling with this piece, how do you *do this*, what do you do, and that always helps. It's so much faster if you have someone that you can talk to you as opposed to just struggling through it yourself. (March Focus Group A)

Through the focus group interviews, the researcher found that the participants recommended other ways of collaboration that could be added to the virtual PLC. These different

ways included using Google Meets and face-to-face meetings. Dee suggested in the focus group that this type of collaboration would allow the participants the opportunity to do a walk through, showcase, or problem solve technology resources.

Using a reflective journal, the researcher recorded that the participants reached out to the researcher 28 times for collaborative conversations, including through face-to-face, phone calls, and e-mails. One example of collaboration occurred with the app, Whiteboard, regarding how it could be used with students. The researcher and Amber worked through the app to learn how it worked and discussed ways to integrate the technology into lessons. Another collaborative moment occurred over the phone when the researcher worked with Andrew on how he wanted to use Google Meet with face-to-face students, virtual students, and the Junior Achievement instructor. The findings indicated that the virtual PLC intervention fostered a safe place for participants to collaborate, ask questions, and learn through the discussion board, with the bonus of face-to-face conversations, phone calls, and e-mail access. These findings were found to be similar to the Booth and Kellogg (2015) and McConnell et al. (2013) PLC studies, where the PLC allowed teachers opportunities to expand their professional networks through collaboration and conversations with their peers.

Technology integration. RQ6, to what extent did teachers' technology integration change after participating in the virtual PLC, showed technology integration evaluated through the survey and focus group interviews. Qualitative thematic analysis occurred through Part II of the pre/post survey and focus group interviews. Through thematic analysis, the researcher identified patterns and codes that supported the theme of technology integration, including Google Meets, differentiated instruction, blended learning, and app resources (Appendix K). From the December focus group interviews to the March focus group interviews, Dee and

Christy found that their technology integration changed from participating in the virtual PLC but stated there remained room for growth. Christy indicated in the December Focus Group A that COVID-19 policies and plans implemented by the school district, including blended learning, caused her to not put more time into the virtual PLC. In December Focus Group A, Dee stated the following:

> To be honest, my intention of technology [usage of technology] has not changed drastically, but I appreciate having other people volunteering these resources. Because I feel like not having been given a whole lot of front-loaded support, it's been really nice to go in and say oh that would work for this or you know just other people's ideas because we don't get to meet here at all face to face, ever.

Of the seven participants in the two March focus group interviews, five had seen growth in their technology integration from participating in the virtual PLC. During March Focus Group B, Elizabeth described the following of how technology integration changed after taking part in the intervention:

> I can say it has for me [technology integration change]. I know in the beginning of the year when we first started it [the virtual PLC] one of the first posts [on the discussion board] and Amber had talked about using the breakout rooms. I had actually talked to her one on one about it, because I was trying every day to find lessons that can now be virtual for those people at home, that we're teaching virtually. So, I have used the breakout rooms to have the kids peer edit and it went really successfully, and I was able to join. So that helped me a lot just seeing that someone else had done it and giving me tips on how to do it and what to do.

Having access to the virtual PLC helped create a safe and friendly place for participants to ask questions and gather support with technology integration.

In the focus group interviews, one example that participants had for technology integration in their classroom entailed using apps and sites as review games with students. For example, Brittanie, in March Focus Group A, stated the following:

> I would say Gimkit, and those kinds of websites to do more review for particular chapters or use it to open up a class to remind students of what we did in the last class. I definitely use that more often than I had previously.

Other examples mentioned in the focus group interviews included Google Meets and breakout rooms used with blended learning, apps, and sites to differentiate instruction. Linda explained in the March focus group, she differentiated her instruction through apps, assigning her students different activities depending on where they were in math lessons.

Part II of the pre/post survey included two open-ended questions on technology integration. The first question asked the participants what they would like to learn about with computers and technology integration. The participants indicated in the pre-survey, they wanted to learn more about breakout rooms, digital documents, blogs, new programs, and blended learning. The researcher used these topics to build the questions used to engage participants in the discussion board. For example, the researcher posted the following on the discussion board in November: “Hi all, has anyone come across a technology tool they are using right now that is working great for face-to-face and virtual? Does anyone have a lesson they would like to share that went really well with technology integration?” In the post-survey, the participants still wanted to learn about technology resources, Google features, and social technology.

The second question asked participants about the one thing that influenced them the most in technology integration. In the pre-survey, the participants cited Google Suite and one-to-one technology as influencing factors. The post-survey showed influencing factors as including the COVID-19 pandemic, remote learning, and students having access to technology. Collaboration with peers was an influencing factor identified by multiple participants in both the pre- and post-survey.

Quantitative analysis of the pre/post survey occurred through descriptive statistics, including the mean and standard deviation. Table 14 provides the results of technology integration subsection of the pre- and post-survey ($N = 15$).

Table 14

Descriptive Statistics Results of the Pre/Post Survey

Category	Pre-survey		Post-survey	
	Mean	Standard deviation	Mean	Standard deviation
Commitment to using computers to enhance student learning	4.3	1.0	4.2	0.8
Teaching with emerging technologies	3.9	1.1	4.5	0.8
Teaching with technology	4.2	0.8	4.6	0.6

The participants believed there was an overuse of technology, thus taking steps back to not using technology for every part of the lesson. Dee shared the following in March Focus Group B:

> I would also say like now I've tried to lessen up on some of the digital stuff just because we've focused so much on that. So, I've kind of taken a step back, but in math I'm using a lot of tech resources for those that need to be pushed further when I'm trying to teach the group in person, but some of the folks already understand. So I've pushed them to do stuff that's digital. Then they're just not sitting there waiting, so that's kind of nice for differentiating instruction.

The qualitative findings indicated little to no changes of teacher technology integration occurring from participating in the virtual PLC. The teachers reported growth in their technology integration knowledge during the focus group interviews. Those participants who indicated technology integration growth in the focus group might have been influenced by the demand of having to use blended learning due to the COVID-19 pandemic, as discussed in the limitations.

Conclusions

The goal of the virtual PLC was to create a platform for support and collaboration to build teacher confidence and skills with the long-term outcome of building teacher technology integration. The virtual PLC was built with constructivist and connectivist approaches to learning where participants could build on their pre-existing knowledge and personal learning experiences through discussions and collaborations built on a digital learning platform (see Ernest, 2010; Gerard & Goldie, 2016; Siemens, 2004). This discussion and collaboration occurred in the virtual PLC through the discussion board, interactions with the researcher, and recommended apps and sites. The Google site as the virtual PLC created a digital learning platform where participants took part asynchronously, working around their schedules and time, as well as when they needed to find resources or support.

The study had a small sample size of 15 participants. The unique circumstances of the school year, which might have influenced recruiting participants. The research was analyzed with process and outcome evaluation research questions. Data were analyzed concurrently to measure implementing the virtual PLC. The process evaluation research questions were used to measure the fidelity of implementation, including adherence, quality of the TSIS delivery, and participant responsiveness. The outcome evaluation research questions were used to measure

technology integration skills, confidence in technology integration, technology integration support, collaboration, and technology integration.

After reviewing the conceptual framework of the problem of practice with the data analysis and discussion of the findings, the researcher updated the framework to match the findings, including adding the specific training and support to a virtual PLC. Figure 6 shows the updated problem of practice's conceptual framework.

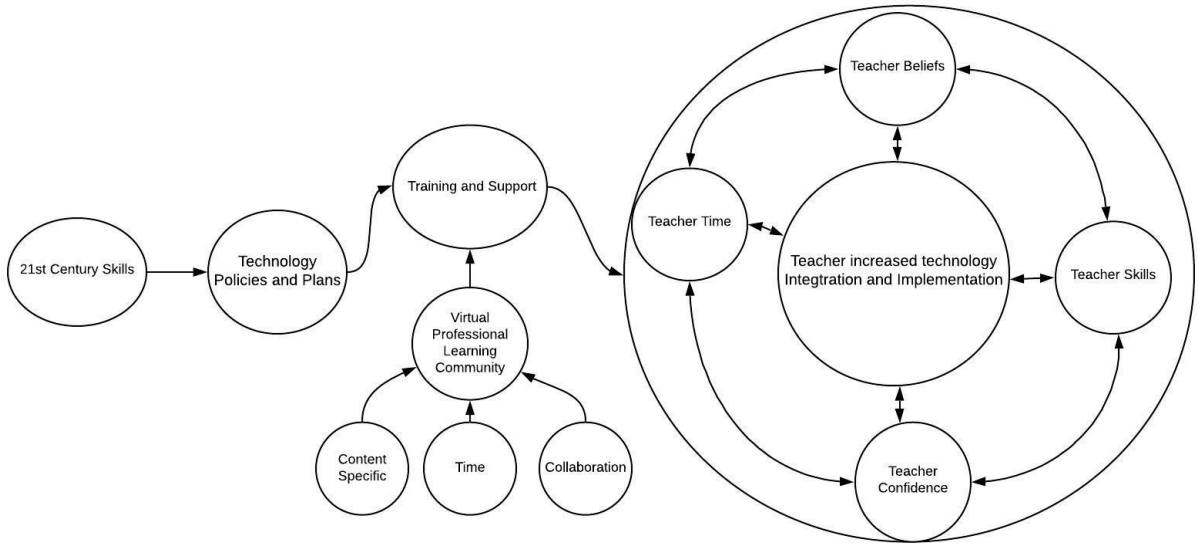

Figure 6. Problem of practice's updated conceptual framework.

Teacher instructional time was added to the inner circle of having an impact on increasing teachers' technology integration. The original framework had time outside the direct influence on teachers and was placed with training and support. Time was determined by the type of professional learning provided to the participants. The findings of the study, especially in the focus group interviews and in Part II of the survey, showed that participants wished they had more professional learning time on the virtual PLC, but due to other outside influences, they could not spend much time on the virtual PLC. Throughout the virtual PLC, the participants had to decide where best to spend their professional learning time. Thus, teacher time was placed in

the center of factors that influenced teacher technology integration. The participants chose where to use their professional learning time among planning, conferences, training, and faculty meetings. In several other studies, researchers defined time as a barrier, even after participants took part in interventions (Keengwe & Onchwari, 2009; McConnell et al., 2013; Song & Bonk, 2016; Unger & Tracey, 2013). Overall, the other areas of the conceptual framework matched the findings in this study, as well as the research literature.

Discussion

The researcher created the virtual PLC using Google Site as a digital platform. The participants had access to resources, support, and collaboration opportunities. The participants used the virtual PLC to acquire resources and support to build their technology integration skills and confidence. The findings of the study indicated that the discussion board section of the virtual PLC was supportive for creating a platform for the participants to ask questions, seek support, and collaborate on lessons and activities. The participants also recommended apps and sites that they found useful in their classrooms.

In reviewing the findings of fidelity of implementation, the researcher adhered to the planned intervention as intended. The participants indicated during focus group interviews, the virtual PLC was useful, with the discussion board being the most useful part. Data from the focus group interviews, Google Analytics, and the reflective journal showed that participant responsiveness occurred through the discussion board (n = 9) and face-to-face, over the phone, and e-mail interactions with the researcher. Kamalodeen and Jameson-Charles (2016) categorized participants by how they took part in the study, ranging from those participants who took information but did not interact, content consumers, and window-shoppers to participants fully engaged in the study, collaborators, and content producers. Like Kamalodeen and Jameson-

Charles (2016), the researcher placed six participants in the virtual PLC under the category of content consumers and window-shoppers. Nine participants were placed under content producers and collaborators. The virtual PLC showed 160 visits, with five participants making apps and sites recommendations, nine interacting on the discussion board, and the researcher posting 11 times to encourage participant engagement. The particpants of the PLC recommended ways to notify participants of added reviewed apps and sites and posts on the discussion board to increase participant responsiveness.

The virtual PLC was developed based on a digital informal approach to learning (i.e., connectivism), where participants voluntarily engaged in the PLC when they had the time and wanted support through collaboration opportunities (Gerard & Goldie, 2016; Marcia & Garcia, 2016; Siemens, 2001). Through the review of research and a constructivist approach, the virtual PLC was built around an informal learning platform, providing a place to access resources, sharing, and collaborating (Ernest, 2010; Greenhow & Askari, 2017; Kamalodeen & Jameson-Charles, 2016; Rashid et al., 2016; Song & Bonk, 2016). Therefore, the researcher conducted the virtual PLC through a Google site for participants to seek and access resources, support, and collaboration with their peers. Like the Kamalodeen and Jameson-Charles (2016) and Song and Bonk (2016) studies, the findings showed that the virtual PLC created flexible access to support and resources for the participants, specifically through the discussion board or easy access to the researcher.

In discussing the outcome evaluation findings, the researcher found the participants collaborated and gained support on technology integration during the virtual PLC through observations of the discussion board and interactions with the researcher. The survey did not show support changing from the pre- to post-survey but showed that participants rated support as

highly influential from peers and access to technical support. The little difference in the survey results could be due to the participants answering the pre-survey based on what they believed the researcher wanted to hear, being more honest with their answers on the post-survey. The virtual PLC was another avenue for participants to have technology integration support with their colleagues. The participants indicated that having synchronous meetings face-to-face or virtually would be a bonus to the virtual PLC, creating more opportunities for collaboration with colleagues and getting support with technology integration than before. In McConnell et al. (2013), participants similarly indicated preferring face-to-face interactions but found virtual an effective alternative. Other researchers similarly found that adding face-to-face interactions could increase collaboration, access to resources, and support (Booth & Kellogg, 2015; Vavasseur & MacGregor, 2008).

Reviewing the findings of teacher confidence, skill levels, and technology integration, the results indicated growth from data collected in the focus group interviews. In the focus group interviews, the participants indicated that they had grown in their technology integration skills and confidence. The participants explained in both the December and March focus group interviews, time and the COVID-related district blended learning plan had a negative impact on growing their technology integration skills. These two factors might have also affected participation in the virtual PLC. Brinkerhoff (2006) similarly found time as a factor, indicating the need for extended time and a hands-on approach to building technology skills. Due to the COVID-19 pandemic and blended learning requirements by the school district, all the participants had to use technology in a greater capacity than prior. The increase in using more technology might have affected the participants' skills and confidence, even without the virtual

PLC. However, having a virtual PLC at this time might have given the participants comfort and confidence, knowing they had support for help.

Limitations of the Study

The limitations of the study included sample size, generalizability, time, and external factors. The researcher intended to have at least 30 teachers from three schools in the Ocean School District for a more rigorous statistical analysis, according to research (O'Leary, 2014). The researcher found that due to time constraints and outside influences, such a sample size could not be recruited ($N = 30$). Therefore, the quantitative findings from the descriptive statistics were limited because of the small sample size ($N = 15$), (see Creswell & Plano Clark, 2011; O'Leary, 2014). The small sample size also affected the researcher's ability to generalize the study. The researcher would have needed a larger representation of the teacher population to generalize the study (see O'Leary, 2014). Another limitation dealing with generalizing the study was that all the participants, except for one, were from the researcher's school.

Another limitation of the study was time, which influenced the recruitment process and time spent on the virtual PLC. The participants discussed time during the focus group interviews and Part II of the survey. Amber stated she was not as active as she intended on the virtual PLC: "Time factor and being pulled in a lot of different directions. And honestly, sometimes I forget about it" (December Focus Group B). In the survey, the participants indicated that more time with the technology and their colleagues could help with technology integration. Other researchers found time as a limitation discussed in the literature review (Keengwe & Onchwari, 2009; Song & Bonk, 2016; Unger & Tracey, 2013). In the virtual PLC, time was limited because the participants had other influences affecting where their time needed to be spent such as the COVID-19 pandemic and blended learning classrooms.

Implications for Practice/Recommendations

The researcher has several recommendations for the virtual PLC, including having a synchronous component, notifications, and video recordings. Through the focus group interviews, the researcher gathered recommendations by the participants that might strengthen and build participation with a virtual PLC. The first recommendation entails adding opportunities for synchronous meetings: participants meet face-to-face or through Google Meets to collaborate with each other. They can share what works with technology integration; ask for help or suggestions with technology integration; and show how different apps, sites, or tools work in real-time.

Another recommendation made during the focus group interviews entails built-in notifications. One type of notification occurs when an app or site has been added to the reviewed apps and sites section of the TSIS. The other suggested type of notification entails when posts are made on the discussion board. Currently, the program used for the discussion board only sends notifications to participants who make a post. Those notifications inform participants of who has commented on their posts. The participants of this study stated that they wanted notifications showing when someone posted on the discussion board. During the study, the researcher sent e-mails to help with this concern.

The last recommendation entails allowing participants to upload video recordings on the discussion board and recommended apps and sites. The video recordings can include information about using the recommendation, suggestions and support, and asking for help. Each of these recommendations may create a stronger virtual PLC to strengthen and build collaboration and support for teachers' skills and confidence with technology integration.

Future Research

The findings showed the virtual PLC as supportive in creating a digital informal learning platform for teachers to collaborate and support each other with technology integration. Future researchers should focus on the length of the study, sample size, informal learning, synchronous *vs.* asynchronous, connectivism, how time affects teachers' skills and confidence, and teachers' technology integration to understand further the effect of virtual PLCs on technology integration. Conducting a study with a more robust sample size and over the course of a school year may strengthen the findings of the virtual PLC and help to understand better teachers' interactions among different schools in the school district.

Future researchers should also focus on understanding informal learning including using a digital platform. What type of professional learning can take place informally, what types of platforms are best to use, and virtual versus face-to-face. Having a better understanding of how an informal learning platform, like a virtual PLC, can change teacher technology skills and confidence levels supporting technology integration could help in providing teachers access to technology learning on their time, opportunities for collaboration, and acquiring support. Further research on virtual and face-to-face opportunities for learning can also help in creating a professional learning community that has the right balance for teachers getting support and collaboration opportunities.

Another area that could help with technology integration support and collaboration opportunities is to expand research on the recommendations of adding opportunities for participants to meet synchronously either through a virtual platform or in-person. Understanding how adding opportunities for participants to collaborate with each other synchronously may help to expand the virtual PLC in building collaboration opportunities supporting teacher technology

integration skills and confidence. Researching similar studies could help to find the right balance of creating synchronous opportunities for the teachers that would get enough participation for the meetings to be productive.

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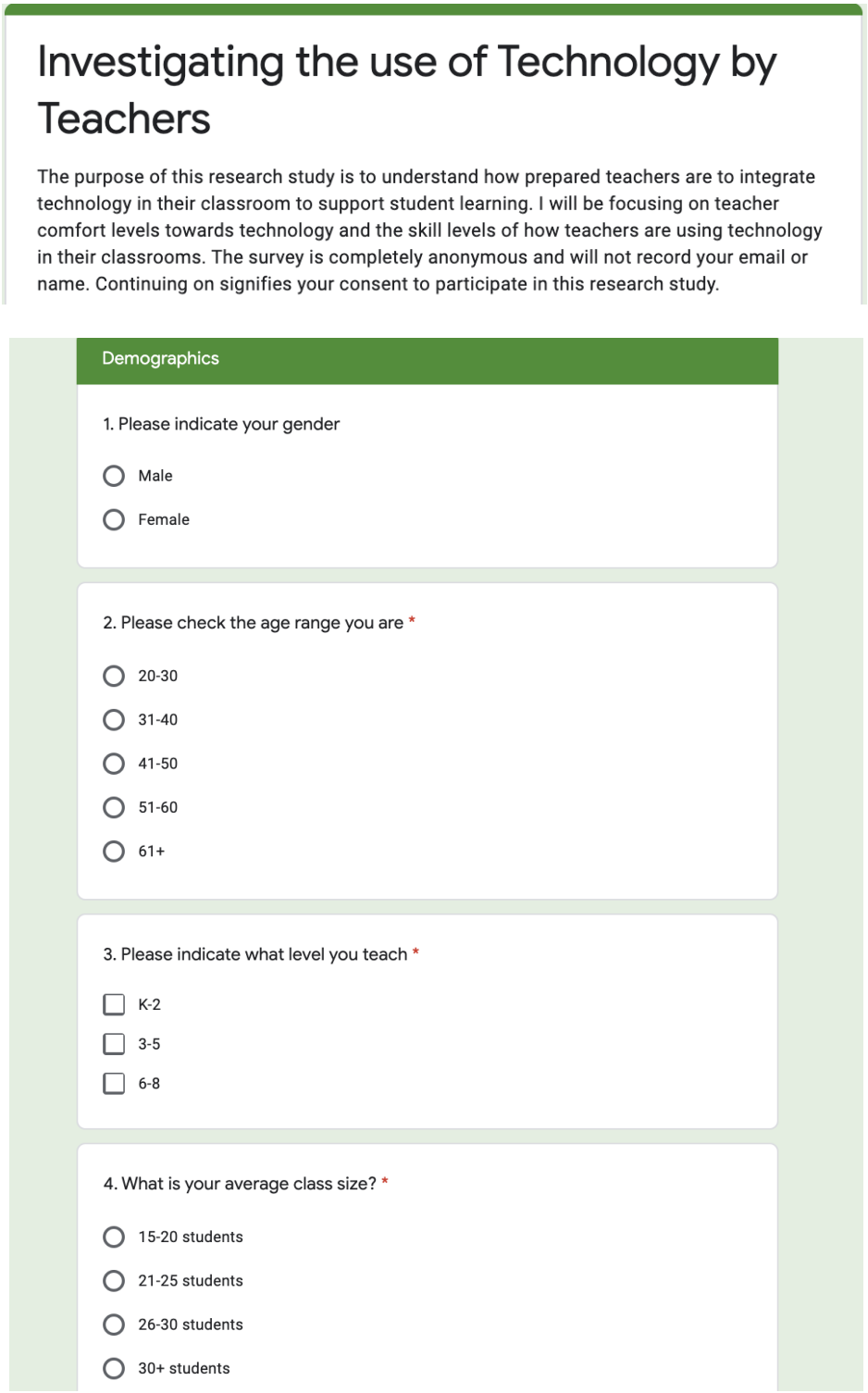
Appendix A: Investigating Technology Teachers Survey



Investigating the use of Technology by Teachers

The purpose of this research study is to understand how prepared teachers are to integrate technology in their classroom to support student learning. I will be focusing on teacher comfort levels towards technology and the skill levels of how teachers are using technology in their classrooms. The survey is completely anonymous and will not record your email or name. Continuing on signifies your consent to participate in this research study.

Demographics

1. Please indicate your gender

- ○ Male
- ○ Female

2. Please check the age range you are *

- ○ 20-30
- ○ 31-40
- ○ 41-50
- ○ 51-60
- ○ 61+

3. Please indicate what level you teach *

- ☐ K-2
- ☐ 3-5
- ☐ 6-8

4. What is your average class size? *

- ○ 15-20 students
- ○ 21-25 students
- ○ 26-30 students
- ○ 30+ students

5. Please check the highest level of education you have completed *

- ○ Bachelor
- ○ Bachelor +18
- ○ Masters
- ○ Masters +30
- ○ Doctorate

6. How many years of teaching experience do you have? *

- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ 20+ years

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Technology Use

7. How often do you use technology in your classroom? *

- ○ Daily
- ○ 2-3 times a week
- ○ Once a week
- ○ 2-3 times a month
- ○ Monthly
- ○ Less than monthly

8. Please check all the technology you use in your classroom *

- ☐ Chromebook
- ☐ I-pad
- ☐ Smart Phones
- ☐ Smartboard
- ☐ Projector, ELMO, Ladybug
- ☐ Desktop Computer or Laptop Computer
- ☐ Google Drive and/or Microsoft Office
- ☐ Google Classroom
- ☐ Videos (youtube or other online resources)
- ☐ Email
- ☐ Digital and Video Cameras
- ☐ Other: _____

9. Please check the technology your students use in your classroom *

- [ ] Chromebook
- [ ] I-Pad
- [ ] Smart Phones
- [ ] Smartboard
- [ ] Projector, ELMO, Ladybug
- [ ] Desktop Computer or Laptop Computer
- [ ] Google Drive and/or Microsoft Office
- [ ] Google Classroom
- [ ] Videos (youtube or other online resources)
- [ ] Digital and Video Cameras
- [ ] Other: _____

10. Does your school participate in 1:1 technology? *

- ( ) Yes, please answer 11 & 12
- ( ) No, please go to 13

11. If they do participate in 1:1 what device do students use

- ( ) Chromebooks
- ( ) I-pads
- ( ) Laptops
- ( ) BYOD (Bring your own device)

12. How often are students using this 1:1 device in your classroom?

- ○ Everyday
- ○ 2-3 times a week
- ○ Once a week
- ○ 2-3 times a month
- ○ Monthly
- ○ Less than monthly

13. How do your students use technology to learn in your classroom? (Please check all that apply) *

- ☐ to take notes
- ☐ to write papers
- ☐ to research
- ☐ to create projects
- ☐ to watch videos
- ☐ to collaborate with peers (ex. communicating virtual)
- ☐ to participate in student centered approaches to learning
- ☐ Other: _____

14. Does your school district have a technology plan? *

- ○ Yes
- ○ No
- ○ I don't know

15. Does your school have a technology plan or technology goals for the school?

- ○ Yes
- ○ No
- ○ I don't know

Training and Comfort Level

16. How important do you believe having a technology plan is? On a scale of 1 to 5 (1 being not important and 5 being extremely important) *

	1	2	3	4	5	
Not important	○	○	○	○	○	Extremely Important

17. How important is technology to your lesson? *

	1	2	3	4	5	
Not important	○	○	○	○	○	Extremely important

18. How comfortable are you in creating technology rich lessons for your students? *

	1	2	3	4	5	
Not comfortable at all	○	○	○	○	○	Extremely comfortable

19. How important is it for your students to use technology devices (Chromebooks, I-pads, or Laptops) in the classroom? *

	1	2	3	4	5	
Not important	○	○	○	○	○	Extremely important

20. How skilled or comfortable are you with using the provided technology? *

	1	2	3	4	5	
No understanding at all of using technology	○	○	○	○	○	Expert on using technology

21. How accessible is support for implementing and trouble shooting the technology you use? *

	1	2	3	4	5	
Difficult to access	○	○	○	○	○	Extremely accessible

22. How supported do you feel with using the provided technology (i.e. Chromebooks or I-pads) in your classroom? *

	1	2	3	4	5	
Not supported at all	○	○	○	○	○	Extremely supported

23. If you feel supported or extremely supported, who or what is the support. Please describe below. If a person is the support please describe their role in your school or district.

Your answer

24. What learning opportunities have you participated in on understanding how to use the Chromebooks or I-pads? *

- [ ] Professional Development provided by the school district and/or your school
- [ ] Participated in a technology cohort or class that lasted for a semester
- [ ] Conferences
- [ ] Workshops
- [ ] Training not provided by school district
- [ ] Other: _____

25. Have these learning opportunities enhanced your technology skills?

- ○ Yes
- ○ No
- ○ Somewhat

26. How often do you participate in technology training's? *

- ○ Every week
- ○ 2-3 times a month
- ○ Once a month
- ○ Twice a school year
- ○ Once a school year
- ○ Never
- ○ Other: _____

27. Which of the following would help to integrate technology in your classroom? *

- [ ] Training occurring monthly or weekly throughout the school year
- [ ] Professional develop provided by district or school
- [ ] Technology Cohort lasting a semester long
- [ ] Technology coach assigned specifically to your school
- [ ] Technology support provided by the school district technology department
- [ ] Time to collaborate in PLC's, both grade level and subject level
- [ ] A technology plan mapping out the goals of the school's idea of using technology
- [ ] Other:

28. What method of technology training would you prefer? *

- ( ) Virtual training
- ( ) In person training
- ( ) Hybrid (in person and virtual)

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Appendix B: E-Mail Invitation

Dear Teachers of School A,

I am conducting a needs assessment for my dissertation work through Johns Hopkins University. The purpose of this needs assessment is to understand how prepared teachers are to integrate and implement technology in their classroom to support student learning. The survey is completely anonymous and will not record your email or name. It will take approximately 30 minutes to complete. If you are able to complete the survey, please click into the Google form link which will start with the informed consent.

https://forms.gle/XS5SPchvuv2j5yzf9

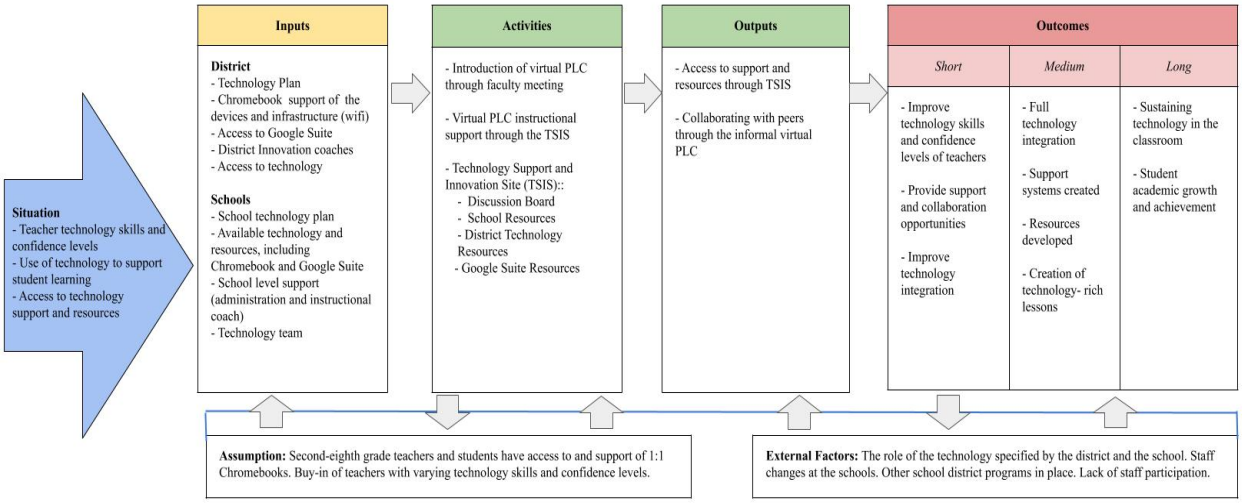
Sincerely,

Brielle Kociolek

Researcher

[redacted]

Appendix C: Logic Model



Appendix D: Summary Matrix

Table D1

Summary Matrix

Research question	Constructs	Measures	Data collection	Data analysis
RQ1A: To what degree did the intervention as implemented adhere to the intervention as planned?	Adherence	Discussion board	Weekly check of board	Thematic analysis (Braun & Clarke, 2006)
		Reflective journal	Throughout the intervention	Thematic analysis (Braun & Clarke, 2006)
RQ1B: To what degree did participants report the virtual PLC as useful?	Quality of TSIS delivery	Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)
		Discussion board	Weekly check of board	Thematic analysis (Braun & Clarke, 2006)
RQ1C: To what extent were participants engaged with the content of the virtual PLC?	Participant responsiveness	Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)
		Google analytics	Site analytics were monitored at the end of each week of the intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
		Apps & sites Google form	Recommendations were monitored at the end of each week of the intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
RQ2: To what extent did teachers' report that their skills levels changed after participating in the virtual PLC?	Technology integration skills	Pre/Post Survey	Pre- and post-intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
		Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)
RQ3: To what extent did teachers' technology confidence change after participating in the virtual PLC?	Confidence in technology integration	Pre/Post Survey	Pre- and post-intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
		Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)

(continued)

Research question	Constructs	Measures	Data collection	Data analysis
RQ4: In what ways did participant support for technology integration change after participation in a virtual PLC?	Technology integration support	Discussion Board	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)
		Part II Pre/Post Survey	Pre- and post-intervention	Thematic analysis (Braun & Clarke, 2006)
		Apps & Sites Google form	Recommendations were monitored at the end of each week of the intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
RQ5: How did teachers collaborate during their participation in a virtual PLC?	Collaboration	Discussion Board	Mid and end of the intervention board	Thematic analysis (Braun & Clarke, 2006)
		Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)
RQ6: To what extent did teachers' technology integration change after participating in the virtual PLC?	Technology integration	Pre/Post Survey	Pre- and post-intervention	Descriptive statistics (Creswell & Plano Clark, 2011)
		Part II Pre/Post Survey	Pre- and post-intervention	Thematic analysis (Braun & Clarke, 2006)
		Focus group interviews	Mid and end of the intervention	Thematic analysis (Braun & Clarke, 2006)

Appendix E: Pre/Post Survey

Pre/Post Survey

By completing this survey, you are consenting to be in this research study. Your participation is voluntary and you can stop at any time. The data collected from the survey will help to understand technology usage, technology support, teacher technology skills, teacher technology confidence, and technology implementation. The survey should take around 30 mins to complete. Thank you for taking the time in completing the survey.

Your email address (**kociolekb@bcsdschools.net**) will be recorded when you submit this form. Not you? Switch account

* Required

School teaching at

- ◯
- ◯
- ◯
- ◯ Other: _____

Grade level(s) teaching *

Your answer

How many years have you been involved in the 1:1 Chromebook initiative *

- ◯ 4 years
- ◯ 3 years
- ◯ 2 years
- ◯ 1 years
- ◯ Not part of the 1:1 initiative

NEXT

Part 1

Part 1: Technology Proficiency Self-Assessment for 21st Century Learning

Rate the following elements in terms of strongly disagree to strongly agree.
Adapted from the Technology Proficiency Self-Assessment for 21st Century Learning (TPSA C21) questionnaire (Christensen & Knezek, 2017).

I feel confident that I could ... *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
... send e-mail to a friend	○	○	○	○	○
... subscribe to a discussion list	○	○	○	○	○
... create a distribution list to send e-mail to several people at once	○	○	○	○	○
send a document as an attachment to an e-mail message	○	○	○	○	○
keep copies of outgoing message that I send to others	○	○	○	○	○
use the Internet search engine (e.g., Google) to find Web pages related to my subject matter interests	○	○	○	○	○
... search for and find the Smithsonian Institution Web site.	○	○	○	○	○
... create my own web page	○	○	○	○	○

... keep track of Web sites I have visited so that I can return to them later. (An example is using bookmarks.)	○	○	○	○	○
... find primary sources of information on the internet that I can use in my teaching	○	○	○	○	○
... use a spreadsheet to create a bar graph of the proportions of the different colors of M&Ms in a bag	○	○	○	○	○
... create a newsletter with graphics	○	○	○	○	○
... save documents in formats so that others can read them if they have a different word processing programs (e.g., saving Word, pdf, RTF, or text)	○	○	○	○	○
... use the computer to create a slideshow presentation	○	○	○	○	○
... create a database of information about important authors in a subject-matter field.	○	○	○	○	○
... write an essay describing how I would use technology in my classroom.	○	○	○	○	○
... create a lesson or unit that incorporates subject matter software as an integral part.	○	○	○	○	○
... use technology to collaborate with teachers or students, who are distant from my classroom.	○	○	○	○	○

... describe 5 software programs or apps that I would use in my teaching.	○	○	○	○	○
... write a plan with a budget to buy technology for my classroom.	○	○	○	○	○
... integrate mobile technologies into my curriculum.	○	○	○	○	○
... use social media tools for instruction in the classroom. (e.g., Facebook, Twitter, etc.)	○	○	○	○	○
... create a wiki or blog to have my students collaborate.	○	○	○	○	○
... use online tools to teach my students from a distance.	○	○	○	○	○
... teach in a one-to-one environment in which the students have their own device.	○	○	○	○	○
... find a way to use a smartphone in my classroom for student responses.	○	○	○	○	○
... use mobile devices to connect to others for my professional development.	○	○	○	○	○
... use mobile devices to have my students access learning activities.	○	○	○	○	○
... download and listen to podcasts/audio books.	○	○	○	○	○
... download and read e-books.	○	○	○	○	○
... download and view streaming movies/video clips.	○	○	○	○	○

... send and receive text messages.	○	○	○	○	○
... transfer photos or other data via a smartphone.	○	○	○	○	○
... save and retrieve files in a cloud-based environment.	○	○	○	○	○

Part 2

Part 2: Exemplary Technology Integration Survey

Please answer the following questions. Adopted from Exemplary Technology Integration Survey (Ertmer, Ottenbreit-Leftwich, & York, 2014).

If you could put your finger on one thing that influenced you the most in terms of integrating technology in your classroom, what would that one thing be? *

Your answer

Rate your current level of computer proficiency: *

- ○ Very high (i.e., I've written some programs/scripts or courseware, and/or could teach others how to use computers)
- ○ High (I can use computers without referring to manuals/instructions/other help)
- ○ Average (I use applications like word processing, spreadsheets, and/or basic Web searches)
- ○ Fair (I can use applications with assistance)

What else could your school do to support your computer use in your classroom? *

Your answer

Regarding computers and technology integration, what would you like to learn more about? *

Your answer

Describe your most memorable or most useful professional development experience. *

Your answer

If you are given a choice, in which types of professional growth opportunities do you prefer to participate? (Select all that apply.) *

- [ ] Workshops and seminars
- [ ] Conferences
- [ ] District or school sponsored course
- [ ] Online or Web-delivered professional development
- [ ] One-on-one training with technology coordinator or technology aide
- [ ] Group training with technology coordinator or technology aid
- [ ] Release time for department or grade level planning related to technology
- [ ] Release time for individual professional development related to technology
- [ ] Other

If your answer included "other" for the previous question, please explain.

Your answer

If you could make a recommendation to other teachers who wanted to do more with technology in their classrooms, what recommendation would you make? *

Your answer

Rate the following elements in terms of the influence *

	1 Not Applicable	2 Not Influential	3 Slightly Influential	4 Moderately Influential	Extremely Influential
Inservice professional development (workshops, conferences, training, etc)	○	○	○	○	○
Current setting-School environment allows for, or encourages, the integration of technology	○	○	○	○	○
Inner drive-Willingness to spend extra or personal time on developing lessons that incorporate technology	○	○	○	○	○
Personal beliefs/attitudes-Beliefs that technology is important to student learning	○	○	○	○	○
Commitment to using computers to enhance student learning	○	○	○	○	○
Time-Opportunities to explore or "play" with new technologies to incorporate into classroom	○	○	○	○	○
Preservice educational experiences	○	○	○	○	○
Key influential people-Mentors or other personal influences on your technology integration	○	○	○	○	○
Confidence-How comfortable you are with technology use	○	○	○	○	○
Previous success with technology	○	○	○	○	○

Previous failure with technology	○	○	○	○	○
Support/encouragement from administration	○	○	○	○	○
Support from parents	○	○	○	○	○
Support from other teachers or peers	○	○	○	○	○
Class size	○	○	○	○	○
Access to technical support	○	○	○	○	○
Access to the Internet	○	○	○	○	○
Access to hardware	○	○	○	○	○
Access to quality software	○	○	○	○	○
Other:	○	○	○	○	○

If your answers included "other" in the previous question, please explain

Your answer

Are there any other experiences that have influenced your use of technology?

Your answer

Would you be interested in participating in a focus group during the research study and/or once the study is complete? *

- ○ Yes
- ○ No
- ○ Maybe

Appendix F: Focus Group Questions

Opening Script

Say, "Hi all thank you for taking the time to participate in today's focus group. As you know I am conducting a research study on how to support teachers with technology integration. I am collecting data on teachers' technology skills, technology confidence, technology support, and technology integration. The purpose of this focus group is to give you the opportunity to share your perspective on the virtual PLC. This meeting will be recorded through Zoom. Prior to meeting you signed consent to participate in the focus group. At any point if you do not feel comfortable in the discussion you are under no obligation to answer or take part. The recording will go on my secure Google Drive which is password protected. All of the information regarding your identity will be kept confidential. At no time will your name be shared and in the findings a pseudonym will be used for your name. Thank you for taking the time to be a part of the group."

Are there any questions about the purpose or procedure before we start?

Mid-Focus Interview Questions

1. How do you define technology integration in your classroom? How would you compare technology integration vs technology implementation? (Baseline question)
2. (RQ6) How has technology integration in your classroom changed since participating in the virtual PLC?
3. Can you give any examples of lessons, activities, and ideas you have created because of participating in the virtual PLC?
4. (RQ3) Based on where you rated yourself on the pre-survey how would you describe your confidence level now in integrating technology in your classroom?
    a. Has your confidence changed being a part of the virtual PLC?
    b. What parts of the virtual PLC have helped to contribute to your confidence?
5. (RQ2) Based on where you rated yourself on the pre-survey how would you describe your level of technology skills?
    a. Have your skills changed being a part of the virtual PLC?
    b. What parts of the virtual PLC have helped to contribute to your technology skills?

6. (RQ5) What do you consider to be features of the virtual PLC that have fostered collaboration? What recommendations do you have to further collaboration through our virtual PLC?
7. (RQ1) What sections of the virtual PLC have been useful? Explain how they have been useful to you.
    a. What would you like to see in the PLC that is not in there now?
    b. What recommendations would you give me, as the designer of the PLC, for future professional learning in this format?

Final Focus Interview Questions

1. (RQ6) How has technology integration in your classroom changed since our last focus group conversation?
    a. Can you give any more examples of lessons, activities, and ideas you have created as a result of participating in the virtual PLC or networking with other participants?
2. (RQ3) Based on where you rated yourself on the pre-survey and since our last focus group how would you describe your confidence level now in integrating technology in your classroom?
    a. Has your confidence changed as a result being a part of the virtual PLC or another experience? If yes, probe here for if PLC or other – and if other, what.
    b. What parts of the virtual PLC or the other experiences have contributed to your confidence? If yes, probe here for if PLC or other – and if other, what.
3. (RQ2) Based on where you rated yourself on the pre-survey and since our last focus group how would you describe your level of technology skills?
    a. Have your skills changed as a result being a part of the virtual PLC or another experience? If yes, probe here for if PLC or other – and if other, what.
    b. What parts of the virtual PLC or other experiences have helped to contribute to your technology skills? If yes, probe here for if PLC or other – and if other, what.
4. (RQ5) Since our last focus group what features of the virtual PLC have fostered collaboration? What recommendations do you have to further collaboration through our virtual PLC?
5. (RQ1) Since our last focus group what sections of the virtual PLC have you used and found to be useful? Explain how they have been useful to you.
    a. What would you like to see in the PLC that is not in there now?
    b. What recommendations would you give me, as the designer of the PLC, for future professional learning in this format?

Closing Script

Say. “Thank you for taking the time today to participate in the focus group. At this point I will end the recording and you all are able to leave. Thank you”

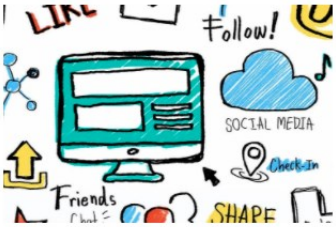
Appendix G: Technology Support and Innovation Site Summary Flyer

Appendix H: Technology Support and Innovation Site

URL to site: https://sites.google.com/bcsdschools.net/tsisite/home

A place to get the help you need and share the resources you love.

For any help or support using this Google Site please contact [redacted]



Discussion Board

- Join the conversation on technology
- Share lessons or activities with your colleagues
- Gain support for technology integration

School Resources

- Technology Available
- Teacher Reviewed Apps & Sites
- Review an App or Site
- Professional Development Opportunities

[redacted]

District Technology Resources

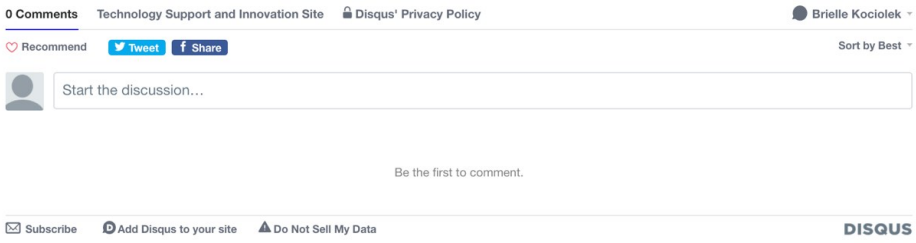
- [redacted] Technology Innovation Team
- Technology Integration Research

Google Suite Resources

- Google Drive
- Google Classroom
- Google Docs
- Google Slides
- Google Sites
- Google Meet

Professional Learning Community

Please use this area to discuss technology questions, share ideas, and gather support from your colleagues on helping to integrate technology. For any help or support using the Google Site please contact Brielle Kociolek at kociolekb@bcsdschools.net



School Resources

Teacher Reviewed Apps & Sites

A continuously updated list of apps and sites teachers are using.

Review an App or Site

Please add to our list of reviewed apps and sites by filling out the Google Form

Technology Available

A list of the technology that can be borrowed to use with students in your classroom.

Professional Development

A list of different professional development opportunities for technology integration

District Technology

[redacted]Technology Innovation Team

Connects you to the district technology coaches and their Google Site

Technology Integration Research

Research and resources on technology integration

[redacted]Blended Distance Learning

Connects you to the District Blended Learning Google Site

Google Suites

Google Drive Resources

- G Suite Learning Center
- 10 Student-Teacher Chrome Extensions

Google Classroom Resources

- 6 Tips for Getting Started with Google Classroom

Google Docs Resources

- What You Can Do With Google Docs

Google Slides Resources

- 20 Google Slides Activities to Add Awesome to Classes

Google Sites Resources

- What Can You Do With Google Sites

Appendix I: Teacher Reviewed App and Sites Recommendation Google Form

Teacher Reviewed Apps & Sites

Please create a review of an App that you think would be beneficial to teachers and students at our school. The review will be added to the TSIS.

Your email address (**kociolekb@bcsdschools.net**) will be recorded when you submit this form. Not you? Switch account

* Required

Name of app *

Your answer

Brief description of app and its potential usefulness *

Your answer

App link/URL *

Your answer

Appendix J: Focus Group E-mail Invitation

Dear Participants,

Please use the Google Forms link (link will be added here once dates are decided for intervention) to indicate the dates and times that you are able to take part in the focus group. Once the dates and times have been determined a follow up email will be sent with the date of participation and a Zoom link to the focus group meeting. If you have any questions, please feel free to reach out to me.

Sincerely,

Brielle Kociolek

Researcher

[redacted]

Appendix K: Codebook

Code	Theme	Definition	Sample evidence
Hardware vs. Software Skills grown No skill growth Still growing skills Direct support Blended learning Virtual PLC and Discussion board	Skills	Ability to integrate technology (Kafyulilo et al., 2014; Mouza, 2009)	"I don't know if my skill level has changed but I definitely feel that I am much more efficient in my intentional use of technology" (Linda, December Focus Group A). "For this year the biggest thing that I've grown in terms of technology is the whole blended learning place. My biggest growth is the actual hardware technology versus the websites and all of that kind of stuff because that's always been something that I like, and I investigate on my own" (Amber, December Focus Group B). "Definitely I think I still have room to grow but I do run over to you and ask for help. I have grown with having this virtual PLC and discussion board" (Christy, March Focus Group A). "I feel like the skill this year that I've gained is hosting Google Meets and teaching virtually through a Google Meet and the breakout groups. I've learned a lot with that specific skill and being a part of the virtual PLC has helped" (Elizabeth, March Focus Group B).
More comfortable Using technology more Less frightened Easy access to support Adapting Awareness Exposure Confidence boost Neutral Confidence Confidence grown Still room for growth	Confidence	Level of technology integration preparedness and willingness (Palak & Walls, 2009; Vannatta & Fordham, 2004)	"I think, you know, the virtual PLC in combination with all the extra challenges of this year have made me feel more confident. I think things like this just take time and getting used to the one new thing and being able to use it well. I think is better than trying to do a whole bunch of different little things" (Brett, December Focus Group B). "My confidence is definitely boosted through the year. And I definitely attribute it to both being in the PLC, seeing some of the questions and answers on your discussion board. And trying it out in the classroom" (Brittanie, March Focus Group A). "I think it is a blend of both this year and being part of the virtual PLC, because with the virtual PLC obviously it is about technology, and you know so much I always call you asking questions. It's the hotline. So, if I struggle with something it's nice having, you know your knowledge I can go there and say hey I'm struggling with this piece, how do you, what do you do and that always helps because it moves these things along so much faster if you have someone that you can talk to you as opposed to just struggling through it yourself" (Andrew, March Focus Group A).

Code	Theme	Definition	Sample evidence
			"I definitely thing I still have room to grow for sure. I think having a space for us to communicate different ideas is really nice" (Dee, March Focus Group B).
Resources or tools Student ways to collaborate/ group work Lessons/ Activities Feedback Connecting with peers Help	Support	Opportunities for teachers to gain access to technology integration resources (Ertmer et al., 2012; Inan & Lowther, 2010a)	"It is your 3110 hotline. If I struggle with something it's nice having you know your knowledge I can go to you and say hey I'm struggling with this piece, how do you, what do you do and that always helps because it's speeds these things along so much faster if you have someone that you can talk to you as opposed to just struggling through it yourself" (Andrew, March Focus Group A). "I like having the list of resources that are teacher reviewed. I can go back to them as I need them. That has been one of my first places I go when I'm looking for something because I know that people have already looked at it already goes through the filters" (Linda, December Focus Group A). "To be honest my intention of technology has not changed drastically. But I appreciate having other people volunteering these resources because I feel like not having been given a whole lot of front loaded support. It's been really nice to go in and say oh that would work for this or you know just other people's ideas because we don't get to meet here at all face to face, ever" (Dee, December Focus Group A). "I am curious how everyone is managing group work. I have tried a few things myself, but I am wondering what is working well for others" (Amber, Discussion Board). "I really want to use Ozobots again this year to review the route of the digestive, excretory and circulatory systems. Any ideas of using Ozobots with our blended students" (Christy, Discussion Board).
Apps/Resources Conversations - one on one - phone calls Blended Learning Discussion board Meeting Face-to-face	Collaboration	Communicating and working with colleagues to share resources, lessons, activities, and help (Duncan-Howell, 2010;Hsu, 2016; Kafyulilo et al., 2014; McConnell et al., 2013)	"In terms of collaboration, it's definitely the discussion board that I thought was very helpful" (Amber, March Focus Group A). "When I see things on there I just, like, oh, there's something cool I just go to the person and ask more questions because it's so much easier. I probably would use the website more to communicate if we didn't have the same planning and not as convenient" (Andrew, December Focus Group B). "I think in a larger school or if this was a district-wide, there would be much more usage of the virtual PLC, but we are so comfortable with just hashing

Code	Theme	Definition	Sample evidence
Virtual			out things in one to one and talking about it, as opposed to doing it online" (Andrew, March Focus Group A). "Thanks to Amber for helping me think this one through. While having to re-think old lessons and ways of doing things. We were starting peer editing and teacher conferencing for our latest writing assignment" (Elizabeth, Discussion Board).
Colleagues support - Feedback - Reviews - Advice Time Access and lack of access Google Meets and Breakout rooms Differentiated instructions Blended Learning and Virtual learning Apps/Sites Resources	Technology Integration	Incorporating technology in the curriculum with a focus on the technology supporting the content being taught and preparing students with skills for the 21st century (Hsu, 2016; Keengwe & Onchwari, 2009; Pittman & Gaines, 2015	"I feel like, when it is really integrated it's sort of like a seamless aspect of the classroom, and students aren't just using it to complete tasks they're using technology to create things, they're doing things they couldn't do previously with just a pencil and paper, it's sort of just in all parts of instruction and student work in all of it" (Amber, December Focus Group B). "Well, I found it helpful at the beginning of the year because I was trying to figure out small group work and I posted a question. Some people came up with ideas and suggestions" (Amber, December Focus Group B). "It's just everyday trying to find lessons that can now be virtual for those people at home, that we're teaching virtually, and so I have used the breakout rooms. Is that what they're called breakout groups to have the kids peer edit and it went really successful and I was able to join" (Elizabeth, March Focus Group B). "We use Gimkit and those kind of websites to do more review for particular chapters or use it to open up a class to remind students of what we did in the last class. I definitely use that more often than I had previously" (Brittanie, March Focus Group A). "I have used Parlay for discussions/discussion boards and it has worked well for both. I have included that in the teacher reviewed apps" (Amber, Discussion Board).

Appendix L: Participant Visit to Each Section of the TSIS

Participant	TSIS	DB	SR	TA	RA	GS	PD	DT	R
1	12	17	4	0	1	2	0	0	0
2	10	11	4	1	1	0	1	0	0
3	3	7	2	1	2	1	1	1	1
4	4	4	4	0	2	0	0	0	0
5	2	4	1	1	1	0	0	0	0
6	1	5	0	0	0	0	0	0	0
7	2	4	1	0	0	0	0	0	0
8	3	2	0	0	1	0	0	0	0
9	2	3	2	0	2	0	0	0	0
10	1	1	0	0	0	0	0	0	0
11	2	2	2	1	2	0	0	0	0
12	2	2	0	0	0	0	0	0	0
13	1	2	1	0	1	0	0	0	0
14	1	2	0	0	0	0	0	0	0
15	1	2	0	0	0	0	0	0	0

Note. TSIS - Technology Support and Innovation Site; DB - Discussion board; SR - School resources; TA - Technology available; RA - Recommended apps and sites; GS - Google suites; PD - Professional development; DT - District technology; R – Research

Brielle Kociolek
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EDUCATION

Johns Hopkins University, Baltimore, MD
School of Education
Doctor of Education: August 2016 – August 2021
Specialization in Technology Integration K-16
Cumulative GPA: 3.70

College of Charleston, Charleston, SC
School of Education, Health, and Human Performance
Master of Education, December 2012
Major: Teaching, Learning & Advocacy
Cumulative GPA: 4.0

Seton Hall University, South Orange, NJ
College of Education and Human Services
Bachelor of Science, May 2008
Majors: Elementary, Early Childhood, and Special Education, and Environmental Studies
Cumulative GPA: 3.38

CERTIFICATIONS

- New Jersey Teacher Certification in Early Childhood Education HQ, Elementary Education HQ, 5-8 Science HQ, 5-8 Social Studies HQ, and Special Education HQ
- New Jersey Supervisor Certificate is currently in process with the NJ Department of Ed and should be done in the next 8 weeks
- South Carolina Teacher Certification in Early Childhood Education HQ, Elementary Education HQ, Middle School Science HQ, Middle School Social Studies HQ, Special Education HQ
- Lunar/Meteorite Sample Disk Certification
- Google Digital Citizenship and Safety Course

HONORS

Teacher of the Year 2014-2015 Daniel Island School
Seton Hall University Dean's List Spring 2004, Spring 2005, Fall 2006, Spring 2008

PROFESSIONAL

Rutgers Division of Continuing Studies, New Brunswick, NJ August 2021 -
Senior iSTEM Education Coordinator

- Working with the Center for Mathematics, Science, and Computer Education

Daniel Island School, Daniel Island, SC Fall 2008-June 2021
7th/8thgrade Science Teacher

- Teaching 8thgrade science: creating standard base science lessons that align to common core and SC standards; bring in hands-on labs and activities to the classroom; creating interactive field studies to local community sites; creating partnerships with local community members to enrich students learning and show real-world connection; using technology in the classroom as a tool and means for students to learn how to be successful 21st century learners.
- Science Fair Director for Daniel Island School: I started and maintain the DIS Middle School Science fair for the past 5 years
- Jr. National Beta Club Sponsor
- 2 funded Donors Choose: Rockets and Sphero Robots

DIS Technology Team

- Created and participate in the DIS technology committee
- DIS tech squad student-run club helping with technology
- Participate in the District technology committee

Science Department Chair for Daniel Island Middle School

- I am in charge of running the science department at DIS which requires me to order and maintain all science supplies. Conduct monthly PLCs for the other science teachers, which includes new materials that need to be given out and how to work with new standards and units.
- Participating in District Science Coordinator meetings to help:
    - Create and write the new science curriculum units
    - Create and upload assessments on Mastery Connect test bank for the district
    - Develop professional learning
- Creating and presenting professional learning at district professional development days.
- SC Office of Standards and Learning: Participated in the Science Standard's Review during the 2019-2020 school year for 21 contact hours.

Johns Hopkins University, Online Aug. 2019 - Dec. 2019

Teacher Assistant

- Assisted in the course Technology and Creative Learning
- Kept track of all discussion posts: reading over them, checking them in, and using Google sheets to progress monitor
- Reviewed anything the professor needed reviewing for the course prior to it being presented to the class
- Helped with leading sync sessions throughout the course

WORK EXPERIENCE

Carolina Youth and Development Center Jan. 2012 - May 2013

- Serving as a tutor to foster children, runaway children, and homeless children at the Carolina Youth and Development Center. Working with these children on an individual base after school to help them complete homework assignments, projects, and career preparation for older students.
- Started as a volunteer position that turned into a part-time job.

Camp Invention June 2009, June 2010, & June 2012

- Served as a science camp instructor for camp invention. Was required to teach science lessons that allowed students to explore and invent science-related topics.

- This position worked with students from kindergarten to fifth grade and lasted for a week each summer.

New Jersey Marine Science Consortium, Sandy Hook, NJ April 2007 - June 2008

- Served as a field guide teaching marine biology, inclusive of the ecosystem and currents to general and special education students
- Teach students about the ocean and beach via utilization of hands-on lessons with sand and shells
- Increase students understanding of Sandy Hook's history including Fort Hancock and the Lenape Native Americans

West Orange Community House, West Orange, NJ Sept. 2007-Dec. 2007

- Taught PowerPoint and web design to 6thgrade students
- Supervised students on how to make their own web page and PowerPoint slides

Seton Hall University, South Orange, NJ Sept. 2004-June 2005

- Tutored college math students in Mathematical perspectives I and
- Tutored college math students in Intermediate Algebra

SKILLS

Technology: Maker Bot (3D printer), Proficient with Google Suite, Microsoft Word, PowerPoint, Excel, Publisher, Outlook, Power Teacher, Inspiration, SMART Board, ELMO, SMART Response, Mastery Connect, Google Drive, Google Classroom, Gizmos (Explorelearning), Chromebooks, Google Expeditioners (VR), MacBooks, i-pads, and Digital Citizenship and Safety

PROFESSIONAL DEVELOPMENT ACTIVITIES

- SC State Science Standards Review Fall 2019
- NASA Space Conference July 2018
- NASA Lunar & Meteorite Sample Disk Program (K-12)
- DIS Technology Committee Member 2017-present
- Making Middle Grades Work Conference June 2016
- Berkeley County Teacher Forum April 2015 – June 2017
- Infusing Technology in the Classroom to Enhance 21st Century Skills - April 2016
- Chromebook Cohort Aug. 2015 - May 2016
- Problem Based Learning workshop, November 2016
- Mastery Connect Professional Development Train the Trainer, Jan. & Aug. 2015
- Science P.L.U.S Institute, Astronomy, June 2015; Chemistry, June 2010
- Science Curriculum Unit Writing Team, Jan-Aug 2014
- NSTA Conference on Science Education in Charlotte, November 2013
- Science Middle School Department Chair, 2009-Present
- Science Professional Learning Community Leader, 2012-Present
- Darkness to Light, August 2014; December 2019
- DIS Middle School Science Fair Organizer, February 2013 & March 2014
- Common Core Training, August 2012 & December 2012
- Community partnership (Adopt-A-Teacher) with the local eye doctor, 2008-Present
- SC Middle School Conference, February 2012
- Hosted a Student Teacher, Fall 2010
- Project Learning Tree Training, August 13, 2010
- Making Middle Grades Work Conference, June 2008 & 2009

- STEM Teacher Training, July 2009
- Darkness to Light, September 2008, Fall of 2016, December 2019
- Science Kit Training 7th & 8th grade, August 2008
- Horticultural Therapy in the Classroom for Special Education Teachers, 2007
- Inclusion and Co-Teaching workshop, 2007